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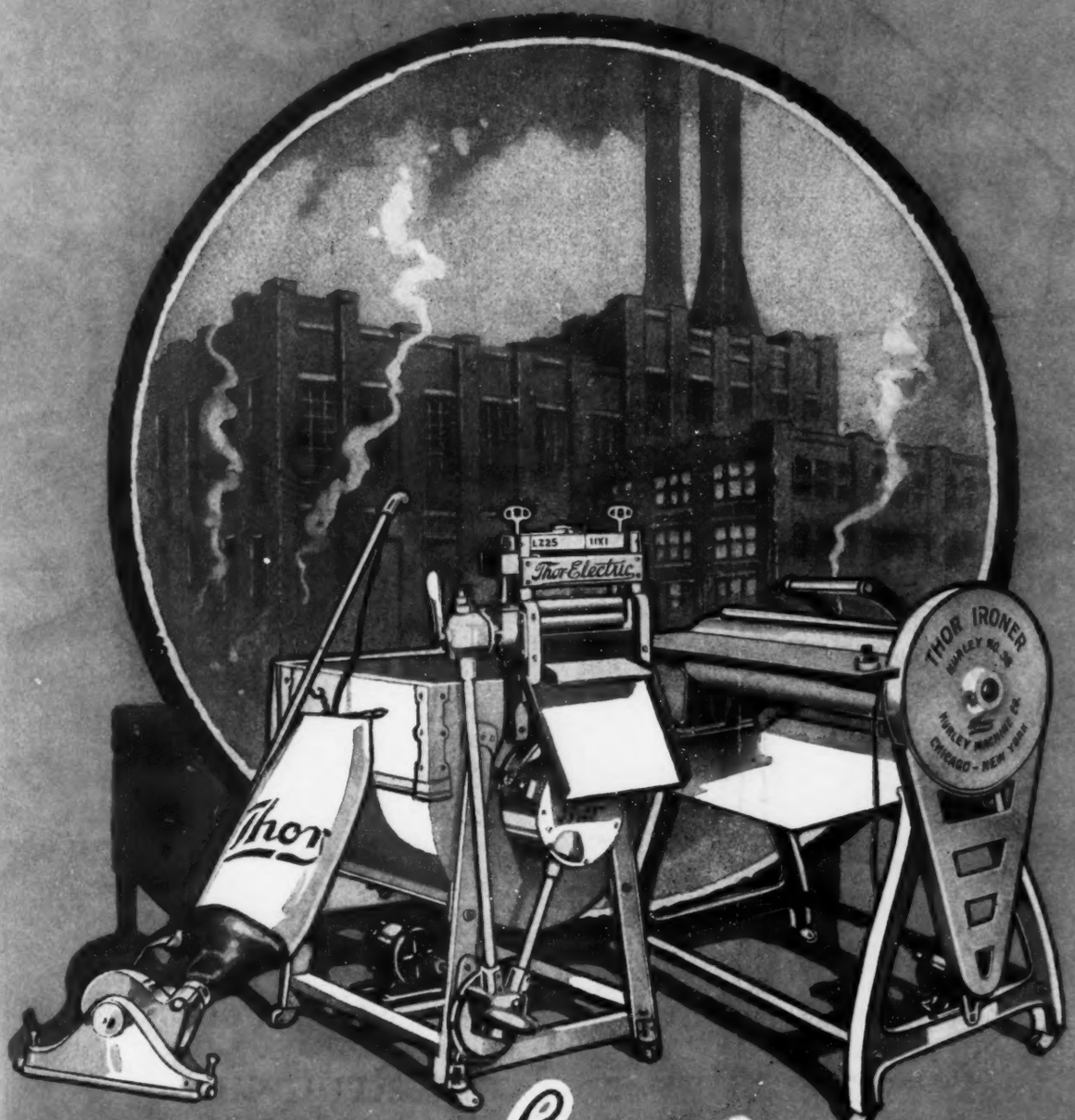

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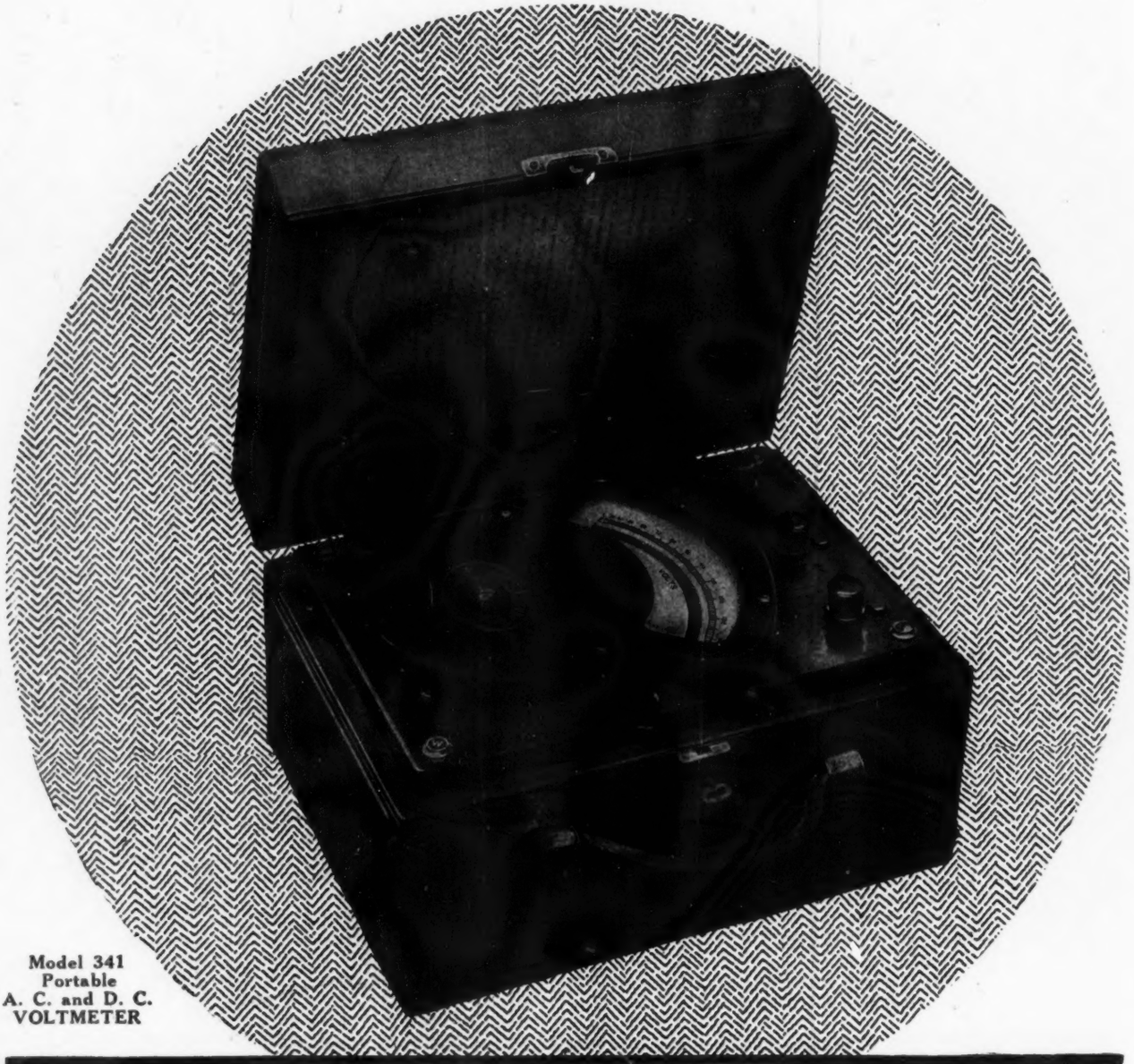

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Electrical World

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Intensify Local Load Development

THE high cost of new construction emphasizes the continuing importance of concentrating central-station sales efforts upon prospective customers as near existing feeders and mains as possible. It is human to long to conquer attractive distant fields and to minimize opportunities close at hand. Extra-system demands must be met if the public wants service sufficiently to pay its total cost, but meanwhile "close-in" work must be pushed with enthusiasm.

Imitation of Research

PRESIDENT PRITCHETT of the Carnegie Foundation for the Advancement of Teaching in his annual report makes some stinging comment on university research. "Much of that which has gone on in American universities under the name of research," he says, "is in truth only an imitation of research upon which great sums have been expended." He also insinuates that universities ought to render some account of their stewardship before seeking additional millions. It is well known that the great industries of this country have, for the most part, had to rely on the efforts and discoveries of their own research laboratories for improvements in the art. The government itself received greater aid from these sources during the war than from the universities. While the latter did render excellent service, they by no means met expectations. Self-examination, which Dr. Pritchett suggests, might improve matters; but a more effective cure for the conditions complained of is for captains of industry to associate themselves intimately with this branch of university work. Otherwise it will continue to drift aimlessly.

Corporations and Legal Technicalities

THE accusation has often been made that the laws are full of technicalities and "jokers" that defeat the ends of justice by making plain the path of the corporation-loving judge who desires a pretext for finding in favor of "big business" and against the community or the humble individual plaintiff. No such motive could possibly have actuated the highest court of New York State in awarding damages aggregating about $5,000 to the proprietor of an electric installation comprising eleven lamps to whom service had been refused by the central-station company because he would not furnish a certificate of safety from the Board of Fire Underwriters. Doubtless the law's technicalities were on the plaintiff's side, and he was within his rights in waiting till the last possible moment to bring his suit so as to recover the utmost dollar; but those who hold that the courts should go behind the letter of the law and decide cases on the grounds purely of equity or presumed legislative intent must admit that here is an instance where the contrary procedure did not help the side commonly supposed always to be the one to benefit from legal technicalities.

International Aspect of Trade

THERE seems to be a very general idea that this country has developed sufficient buying power to absorb in domestic trade that portion of its production which is in excess of the essentials Europe must have. However, the possibility of European countries taking advantage of the international exchange situation to undersell American manufacturers in this market appears to have been overlooked. If this practice were to become general for any length of time, the entire electrical business would be affected by the curtailment of manufacturing operations which might be expected to follow. From the motive of self-protection if not of patriotism the industry should therefore consider the fundamental factors involved and should co-operate with those in other branches of industry who are trying to determine how to meet the situation created by the decline in foreign exchange.

Electric Furnace Operation

AT THE joint meeting of the American Institute of Electrical Engineers and the American Electrochemical Society last week in Boston electrochemists, metallurgists and electrical engineers gave ample testimony to the economic service of the electric furnace in the production of steel and ferrous and non-ferrous alloys. The one thing that is now uppermost in their minds is maximum production in electric furnace operation, the need of trained operators and sufficient practical operating data to make it possible to obtain uniform results in small as well as large installations. Here is a new problem for the electrical engineer, the electric furnace manufacturer and the metallurgist. There were evidences at the Boston meeting that its solution will be promptly furnished.

Adequate Interconnection

THE mere linking up of adjacent electric service systems by tie lines entirely unrepresentative of the generating and transmission capabilities thus brought into relation affords little real test of operating value. Maximum efficiency of interchange involves trunk-line connections between major plants, with carefully planned equipment selected on the basis of a sound financial analysis of latent resources. Interconnection often may be handled piecemeal without implying poor engineering, but more than a bare electrical contact between systems must be provided.

A Street-Lighting Need

A CONSTANT-POTENTIAL multiple system of street lighting has advantages over the series system from practically every point of view except that of control, and it is mainly because there is no satisfactory and efficient method of switching the lamps on and off that the multiple system has not been more widely adopted. This fact was brought out very forcibly in a recent paper by Ward Harrison, read before the American Institute of Electrical Engineers. He pointed out that it is often cheaper to keep multiple lamps burning continuously than to install the series system or the multiple system with proper provision for switching.

The conditions of multiple distribution require the development of a system of switch control, operated without pilot wires and without clock mechanism, but so arranged as to be actuated at will from the station or control point. Existing equipment has been adapted to the use of the multiple system up to the present, but the time has arrived when a means of switching should be developed to meet the special requirements of multiple street lighting. When this has been accomplished an untouched field for street lighting will be opened up in both town and country, and it should then be no more difficult to add street lamps to a distributing system than it is to add residential customers. As long as the fixed charges on the investment required with the present series systems of street lighting are much more than actual cost of energy plus lamp or electrode renewals the full expansion of the business of street and highway lighting cannot be expected.

Transformers for Electric Furnaces

A PAPER read before the British Institution of Electrical Engineers on transformers for electric furnaces was recently abstracted in our Digest of Electrical Literature. Such apparatus is not yet thoroughly standardized, and a consideration of some of its features is therefore especially pertinent. The fundamental peculiarities of a furnace transformer are that it requires a variable voltage ratio and a relatively very low voltage secondary of enormous current capacity. With these requirements come difficulties of design. The author of the paper before us believes, although his conclusion is not universally accepted, that the voltage regulation changes should be made on the high-voltage side. This certainly involves less trouble in design than attempting to regulate the secondary, although possibly the booster may, in at least some instances, provide a way out of the difficulty. The main troubles are those concerned with the very high current values required. The secondary leads should be as short as possible to avoid losses and pretty thoroughly split up and interleaved to escape as far as possible mutual inductive losses and parasitic currents. These are likely to be particularly heavy in such circumstances and are not infrequently complicated by magnetic material thoughtlessly inclosed.

Then, too, the extreme currents are liable to breaking and their sudden variation puts mechanical stresses on the structure of a magnitude difficult to realize until they are figured out. Such limitations on design really have an important bearing on the future of the electric furnace. If the operation of a 40-ton furnace, for example, is concerned, a total transformer capacity somewhere about 8,000 kva. is likely to be called for, which in a two-phase furnace will run to between 40,000 amp. and 50,000 amp. per phase. This amperage would probably have to be divided between four electrodes, even using those of the largest size. Some designers have favored increasing the number of phases, but little has yet been accomplished along that line, promising though it is. Raising the voltage means a struggle against heat problems. With all this there must be a steady effort to improve the power-factor conditions, which, through improper distribution of current, can easily become anything but satisfactory. The whole matter is as yet in a formative stage. The electric furnace is bound to come steadily into greater and greater use, and the transformer problem therefore must receive the keenest attention.

Improvements in Substation Practice

AN EXAMPLE of the concrete embodiment of skillful substation planning is given in this issue in Walter H. Millan's description of the new 15,000-kva. equipment of the Union Electric Light & Power Company of St. Louis. In the development of this important system it became necessary to provide new substation equipment for the 60-cycle distribution in the southern half of the city. From the point of view of design the usual building procedure was reversed. The electrical equipment throughout was first planned and then the substation put around it. This new substation is about 5 miles (8 km.) from the main generating plant, whence the energy is transmitted at 13,200 volts. For a part of this the station acts merely as distributer, sending the current out at the same voltage on three-conductor feeders. The major part of the energy received is, however, transformed for local distribution. The three-phase, four-wire system at 2,600 volts between phase wire and neutral is used, there being about twenty outgoing feeders of this type. The transformers by which the distributing system is fed are of the three-phase construction, capable of an output of 3,000 kva. each when operated as water-cooled units, while as self-cooled units they are good for a continuous rating of 2,200 kva. At present the water cooling is used only at the peak of the load.

The switching arrangements for the feeders deserve special notice. The whole station capacity is arranged to be divided up and operated at present in two, and finally in five, independent sections. This exemplifies the comment we recently made on switchboard design in pointing out the advantage of loose or open relation between feeder groups to lessen the severity of short circuits and the complications of the switchboard. The distribution bus is connected to the feeders by a single set of solid and capacious oil switches, a flexible transfer bus taking the place of the duplicate switches commonly installed. The oil switches are provided with automatic reclosing relays with a time delay. Thus, pending attention to trouble, the main switch may be closed tentatively three times before the effort is finally given up.

Altogether this substation is a capital example of the tendency toward simplicity which has been of late observable. The straight run in definite sequence of each feeder from bus to cable and the conservative use of well-planned switching apparatus are features especially to be commended.

Local Dealer Can Build Good Will for the Central Station

CENTRAL stations need the good will of the public more than they need additions to their connected appliance load. Public good will or ill will toward utilities in no small measure grows out of the feelings of the local dealers toward the local utilities. If all of the electrical men in a city except those employed by the central stations are constantly telling the public that the utility is a grasping corporation, nothing but unfavorable public utility relations can possibly exist. Any central-station merchandising policy, therefore, which antagonizes the local trade and causes it to talk against the utility is an unprofitable policy and should be discontinued, even though the central station may feel that the policy is ethical and that the trade should not object to it. The strength of the electrical trade as a molder of public opinion is growing. The utilities need to add this strength to their own and can do so by making their merchandising policy such that it will not cause destructive competition with the contractor-dealer.

Depth Versus Breadth in Technical Education

EVERY one believes that higher technical education ought to be broad, but this breadth is hardly ever achieved by scattering the student's attention over a number of elementary, disconnected courses. On the other hand, the usual criticism regarding the narrowness of engineering curricula ought not to apply to colleges in which the student pursues only a few well-defined lines of thought throughout the four years. There is both depth and breadth in a course like electrical engineering, provided that the individual topics are laid out systematically and that the student sees the physical foundation of his specialty, its place in the industrial life of the country, the economics involved, the human element and the relationship to the neighboring industries.

When a student gets a smattering of many subjects without the fundamental knowledge of any of them, there is a definite neglect of the methods in which problems should be attacked, of the technique of investigation, and a rather disheartening inculcation of a spirit that is overcredulous and takes on faith what other investigators have done. There is no time for thorough-going, scientific analysis, and in its stead is developed the idea that one can be fit for managerial and administrative duties without first slowly and painfully ascending the ladder toward them through an essentially technical, painstaking and detailed study. Our social structure is such as to encourage this "hit or miss" attitude toward the professional life on the part of the young generation, because of a lack of a definite connection between the student and the industry. He gets an alluring picture of men in leading positions from well-known advertisements, and from his colleagues he gets a disheartening first-hand knowledge of the precarious economic status of purely technical men.

A solution of the problem of how to combine thoroughness and broadness in technical education does not lie in one radical measure that will change the whole educational system, but is to be found rather in a number of improvements and progressive steps. Summer work in a chosen specialty, or at least a year spent in a shop or in the field before entering the technical college, is of considerable importance and assistance, because it not only helps the student to see the chosen branch of engineering, but even helps often to make connections with the company which he may join upon graduation. Another suggestion is vocational guidance in the most general sense, embodying character analysis and psychological tests. In this way the student may be guided in the beginning to the field of endeavor where he may be most happy, whether it be as "trouble shooter" or as a promoter of large hydro-electric projects. There is also urgent need for a rearrangement of courses in such a way that a general bird's-eye view of the whole of the domain of engineering can be obtained in the freshman year, so that only one year is lost in orientation rather than four spent in nibbling at various things in the hope of finding the right one.

True depth in technical education is not opposed to breadth, but they go hand in hand. One who studies deeply one engineering subject in the right way cannot fail to see its manifold ramifications into other fields of human activity and to see, or rather to feel by implication, similar problems involved in other fields reaching into his own. The problem thus narrows down to the selection of broad-gage teachers who can present particular problems in their specialty in the right way.

Iron and Steel Wire for Transmission

COPPER is so well established as the leading metal for use in alternating-current conductors that, except in the case of aluminum, it hardly permits of a rival under normal trade conditions. However, during the war the scarcity of copper for the electric arts made the use of steel wires a temporary necessity. Owing to the relatively high permeability of such steel, the skin effect in these steel wires reduces their effective conducting powers to a very marked degree, even at 60 or at 25 cycles per second. The linear resistance of steel wires to alternating currents is not only considerably greater than to continuous currents at one and the same temperature of operation, but it varies with the strength of the alternating current, ordinarily reaching a maximum value within the range of the wire's carrying capacity. This uncertainty in the electric behavior of steel wires constitutes a serious objection to their use on alternating-current distribution circuits. If a steel wire could be produced which possessed a high conductivity associated with a low transverse permeability, this objection would be overcome to a corresponding degree. It seems possible that steady research might succeed in developing such a steel.

In steel rails, such as are used in electric railway work, it has been shown experimentally that the effective skin depth of penetration at 20 deg. C. to an alternating current of 60 cycles is approximately from 0.5 mm. to 1.2 mm., with an average of about 0.9 mm., the effective permeability reaching values as high as 2,500.

The article by Prof. R. W. Goddard on this subject, appearing in this number, draws attention to the uncertainty of the data ordinarily obtained for finding the linear resistance of steel wires. On the other hand, it is pointed out that from a mechanical point of view steel wires, strung on poles or towers, have decided advantages over copper wires, both from laboratory tests and from actual experience.

Frank Julian Sprague

Pioneer in electrical operation of street railways, originator of multiple-unit train control and an early advocate of steam railroad electrification

ALTHOUGH best known as the father and champion of direct-current railway operation, Frank Julian Sprague's service to the electrical industry has covered all its branches. After graduation from the United States Naval Academy in 1878 and spending five years in naval service, he resigned to enter the employ of Thomas A. Edison in 1883. With W. S. Andrews he worked on the installation of the early lighting plants and developed a mathematical study of the three-wire system of distribution. This led up to his developments in electric motors for stationary and electric railway use. His success in this direction caused him to resign and with the late E. H. Johnson to found the Sprague Electric Railway & Motor Company in 1884. Then followed tempestuous times, now become historical because of the courage and persistence with which he urged the use of electric power for transportation. After installing electric operation on a number of roads he finally demonstrated its possibilities on a larger scale than ever before at Richmond, Va., in 1888. In 1890 the Sprague Electric Railway & Motor Company was absorbed by the Edison General Electric Company. Soon thereafter followed the formation of the Sprague Electric Elevator Company and the Sprague Electric Company to produce Mr. Sprague's developments principally for the electrification of elevators. In 1895 he invented the multiple-unit system of electric train control and in spite of discouragement on all sides proved its practicability on the South Side Elevated Railway in Chicago. This system has since found universal appreciation in this country and abroad.

In a consulting capacity Mr. Sprague has been engaged on a wide variety of engineering problems in the United States and other countries, notably on railway electrification for the New York Central company as a member of its electric traction commission and on electrical manufacturing and design for the Sprague, Otis and General Electric companies. Many honors and medals for inventions and meritorious achievements in electrical engineering have been awarded to him. Mr. Sprague is a past-president of the A. I. E. E., the American Institute of Consulting Engineers and the New York Electrical Society, and during the war he served on the Naval Consulting Board. His name is indelibly written in electrical progress as a brilliant engineer and inventor, a stanch supporter of direct-current electrification and a fearless defender of his engineering convictions. Mr. Sprague was born at Milford, Conn., July 25, 1857.

New Features in Distribution Substations

Electrical Apparatus, First Arranged for Maximum Safety, Simplicity and Convenience, Then Buildings Constructed Around It — Experienced Operator Made Responsible for Construction Details

By WALTER H. MILLAN

Superintendent of Substations Union Electric Light & Power Company, St. Louis

THE growth of light and power business in St. Louis has made it necessary for the Union Electric Light & Power Company to build a 15,000-kva. distributing substation at about the center of its 60-cycle distribution for the southern half of the city. Among the electrical features worthy of attention is the 4,500-volt bus arrangement which obviates the use of duplicate oil switches on feeders. Special provision also is made to confine the oil ejected from any apparatus in case of fire. The building was constructed entirely of reinforced concrete and brick, because conditions of the market would not permit the use of structural steel. The structure, which is 122 ft. x 65 ft. (37 m. x 20 m.), was made to conform to the arrangement of the electrical apparatus instead of the reverse, as is often the case.

The station receives 60-cycle energy at 13,200 volts, three-phase, three-wire, from the busbars of the generating station, about 27,000 ft. (8,200 m.) distant. A portion of this energy is distributed over 4/0 (107.2-sq.mm.) three-conductor outgoing feeders (two are installed, but ultimately there will be five) at the same voltage at which it is received. The major portion is transformed to 2,600/4,500-volt, three-phase, four-wire, and distributed over eight 4/0 (107.2-sq.mm.) four-conductor automatically regulated cables (ultimately to be twenty).

All incoming 13,200-volt feeders are brought underground from the generating station. All outgoing feeders of both voltages leave the substation underground and are carried thus to the point where the first distribution load is taken off, at which point in most cases the feeders are continued overhead.

The main three-phase, 60-cycle transformer units have a self-cooled continuous rating of 2,200 kva. Copper water-cooling coils are provided which when used increase the continuous rating to 3,000 kva., based on 55 deg. C. rise. The water-cooling coils are used only

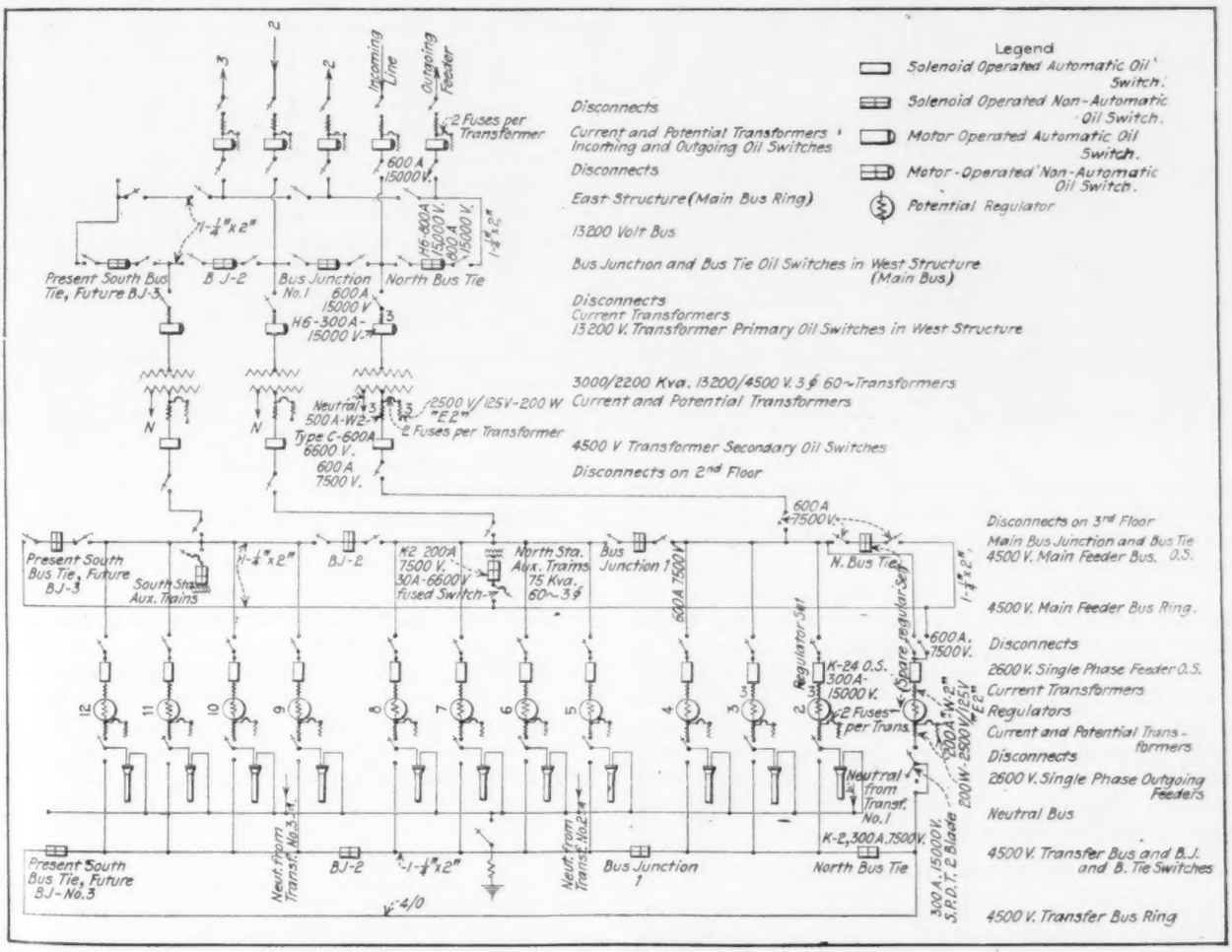

Legend
Solenoid Operated Automatic Oil Switch.
Solenoid Operated Non-Automatic Oil Switch.
Motor Operated Automatic Oil Switch.
Motor-Operated Non-Automatic Oil Switch.
Potential Regulator
Disconnects
Current and Potential Transformers Incoming and Outgoing Oil Switches
Disconnects
East Structure (Main Bus Ring)
13200 Volt Bus
Bus Junction and Bus Tie Oil Switches in West Structure (Main Bus)
Disconnects
Current Transformers
13200 V. Transformer Primary Oil Switches in West Structure
3000/2200 Kva. 13200/4500 V. 3 ϕ 60~Transformers
Current and Potential Transformers
4500 V. Transformer Secondary Oil Switches
Disconnects on 2nd Floor
Disconnects on 3rd Floor
Main Bus Junction and Bus Tie
4500 V. Main Feeder Bus. O.S.
4500 V. Main Feeder Bus Ring.
Disconnects
2600 V. Single Phase Feeder O.S.
Current Transformers
Regulators
Current and Potential Transformers
Disconnects
2600 V. Single Phase Outgoing Feeders
Neutral Bus
4500 V. Transfer Bus and B.J. and B. Tie Switches
4500 V. Transfer Bus Ring
Incoming Line
Outgoing Feeder
2 Fuses per Transformer
600 A 15000 V.
Present South Bus Tie, Future BJ-3
B J-2
Bus Junction No. 1
North Bus Tie
H6-300A-15000 V.
Neutral 500A-W2-
Type C-600A 6600 V.
600 A 7500 V.
2500 V/125V-200 W "E2"
South Sta. Aux. Trains
K2 200A 7500 V. 30A-6600V fused Switch
North Sta. Aux. Trains 75 Kva. 60~3ϕ
Bus Junction 1
N. Bus Tie
Regulator Set
Spare regulator Set
K-24 O.S. 300A-15000 V.
Neutral from Transf. No. 1
K-2, 300A, 7500V.
300 A, 15000 V. S.P.D.T. 2 Blade
Present South Bus Tie, Future BJ-No. 3
Neut. from Transf. No. 3
Neut. from Transf. No. 2
4/0

FIG. 1—ONE-LINE WIRING DIAGRAM OF NEW DISTRIBUTION SUBSTATION AT ST. LOUIS

The station may be operated "split" into two sections (ultimately into five sections). Each section includes one incoming 13,200-volt feeder, one main transformer, a group of four outgoing 4,500/2,600-volt regulated distribution feeders and a section of the transfer bus. The outgoing 13,200-volt feeders are fed from the backbone of the 13,200-volt ring bus.

during the peak load. These transformers are provided with head-block taps on the high-voltage winding for 27,600-25,200-13,800 and 13,200-12,900-12,600 volts, to give flexibility and to make them interchangeable with transformers in other substations. What is ordinarily an advantage in using three single-phase transformers —*i.e.*, open delta operation—does not apply in this case, because the 4,500-volt, three-phase, four-wire system must be connected in "Y." Furthermore, single-phase transformers would have cost more and have taken up approximately twice the space occupied by the three-phase units.

The oil switches used on the 13,200-volt circuits and buses are all of form "H-6," General Electric make. For incoming and outgoing 13,200-volt feeders and the high-voltage side of the transformers the switches are rated at 300 amp., 15,000 volts, arranged "pots in parallel," back and bottom connected. For the junctions in the 13,200-volt bus switches of 800 amp., 15,000-volt rating are used, with the pots arranged in "tandem" and "back-and-back" connected.

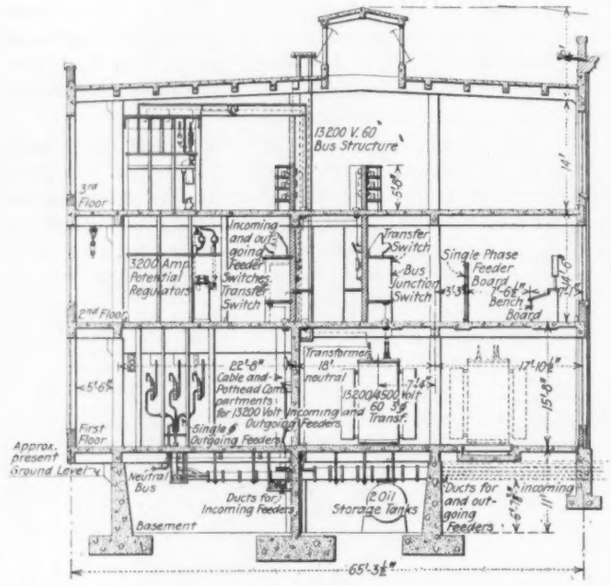


FIG. 2—CROSS-SECTION THROUGH SUBSTATION

No electrical apparatus has been installed in the basement. The structure is arranged in units covering six phases (two feeders) each arranged back to back. The center walls of these units are of concrete into which are cast fiber conduits for the main wiring (No. 4/0 flame-proof wire) and iron conduits for the control wiring. The compartment barriers and end walls are of brick.

UNIT OPERATION OF FEEDER GROUPS

A study of Fig. 1, which is a diagram of the main wiring, will disclose some unique and very interesting features in the arrangement of switchgear seldom found in a station of this character. For example, the station may be divided up and operated in two (ultimately in five) independent sections. The outgoing 13,200-volt feeders may be isolated and operated from either end section of the main bus. The advantage of "split" operation is that it keeps the available short-circuit current within the rupturing limits of the various switchgear and permits the rapid isolation of a section involved in trouble.

In laying out the 4,500-volt distribution bus and feeders a departure from general practice was made in that only a single set of busbars and oil switches are provided. Ordinarily these 4,500/2,600-volt distribution feeders must be kept in service continuously, and for that reason duplicate oil switches have been provided in the past to permit the switchgear being overhauled or repaired. In this case it was decided to use a single set of extra-rugged oil switches and a flexible transfer bus arrangement. The oil switches chosen for this duty are General Electric form K-24, of 300-amp., 15,000-volt rating. They are in single-pole units and are solenoid-operated. These oil switches are very much more rugged than any previously used by the company for the same purpose. The automatic reclosing feature of these switches is described below.

By consulting Fig. 1 it will be noted that one of the end positions for outgoing 4,500/2,600-volt feeders is used as a spare. This spare position is fed from the back section of the 4,500-volt ring bus and in turn feeds the back section of the transfer ring bus, thus permitting its being operated from either end of the station. Each outgoing 4,500/2,600-volt feeder is provided with double-throw double-blade disconnecting switches at the pothead which permit the feeder to be transferred from its own regulator and switchgear to the spare set. During periods of light load a whole section (four feeders) may be carried on the transfer bus, on the single set of regulators of the spare, thus permitting a section of main bus to be killed for repairs or cleaning. This operation may be carried out without interrupting service on any of the feeders involved.

NEUTRAL WIRING IS INSULATED

The neutrals of all outgoing 4,500/2,600-volt feeders are carried from the potheads through floor bushings to the basement ceiling, where a neutral bus runs the full length of the building. All floor bushings and wall are calked with fireclay. It is easily removed and is a protection against fire spreading. The neutrals of all 4,500/2,600-volt feeders, also of the main transformers and the induction regulator, primary neutrals, etc., are connected to this bus through bolted link joints. It might be mentioned that all neutral wiring is treated the same as phase wiring in the matter of insulation in order to permit inserting a limiting resistance between the station neutral bus and the earth at some future date if required. For the present, however, the neutral bus is directly connected to a ground plate made up of a slab of cast iron having an area of about 100 sq.ft. (10 sq.m.) embedded in charcoal and salt. Provision is made for a second one of these grounds to permit overhauling the first.

The 4,500-volt structure, which contains all busbars, switch gear and induction regulators for all outgoing 4,500/2,600-volt feeders, is on three floors of the building (see Fig. 2). The 4,500-volt bus is carried in a horizontal plane at the top of the structure on the third floor. Directly below are compartments containing the disconnecting switches, and next to them are the oil switches. On the second floor and directly beneath

this, phase for phase, are the compartments containing the current and potential transformers and induction regulators. Likewise on the first floor are the compartments containing the double-throw "disconnects" and transfer-bus connection; also the potheads of the cables. In short, the main wiring of each phase of each feeder travels directly downward from the point at which it leaves the bus on the third floor until it joins the other phases at the pothead on the first floor.

PROVISION AGAINST SPREAD OF OIL FIRES

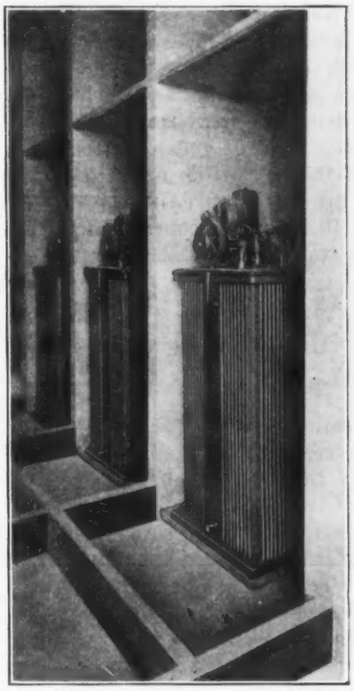
The unit structures containing the induction regulators have concrete curbs on the floor between the structures and joining the barriers forming the regulator compartments (see Fig. 3). It is believed that this arrangement will confine an oil fire to one regulator, or at most to the one in trouble and the one immediately across the aisle. Consideration is being given to the adoption of a similar scheme in connection with the large compartments containing the main transformers.

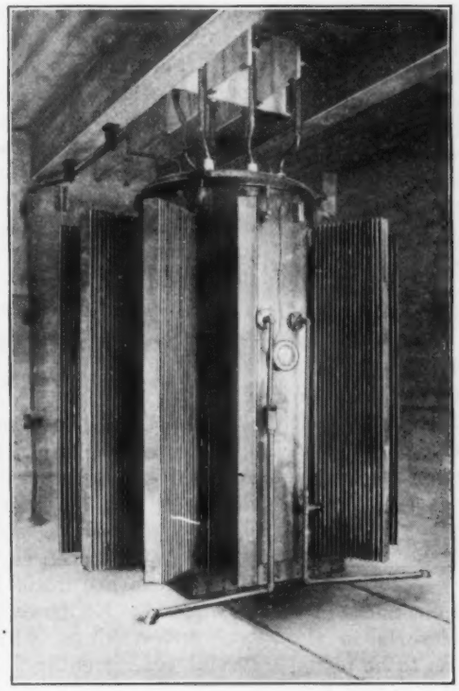
On the second-floor level near the regulator compartments a monorail crane of 2-ton capacity is so arranged that any regulator may be moved around to the other side of the building where a floor hatch permits its being lowered directly to the bed of a motor truck which may be backed into the station. This same crane may be used to handle oil-switch mechanisms and other more or less heavy gear. Some provision is made for removing for repairs all heavy pieces of apparatus used in the substation. A very complete system for handling the transformer oil has been installed in the basement directly below the transformers.

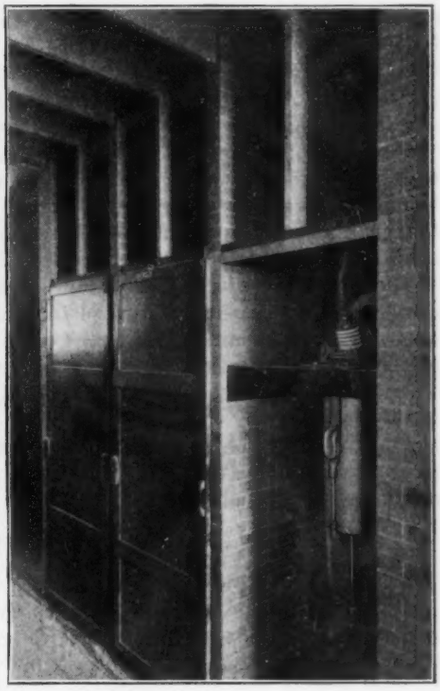
On two control boards on the second floor operating deck (see Fig. 2) are mounted all control switches, instruments and relays for the entire installation. All control gear for the outgoing 4,500/2,600-volt feeders is mounted on a vertical panelboard, and that for all 13,200-volt feeders and junctions, including both high-tension and low-tension sides of the transformers, is mounted on a benchboard.

On the floor of the aisle between the two rows of "H-6" switches on the second floor is a full-size diagram of bus connections at the actual locations. This permits of quickly and accurately locating any set of disconnecting switches or oil switch and tends to eliminate confusion in the mind of the operator when disconnects must be located and opened or closed quickly. This diagram was marked in the granitoid floor with a marking trowel while the cement was fresh.

The iron conduits which carry the control wiring from the vertical boards and the benchboards to the various pieces of equipment are entirely concea'ed, being buried in the concrete of the floors and walls. The conduits all terminate in condulet outlet fittings which are embedded flush in the structure walls, only the porcelain covers being visible. This reduces to a minimum the amount of exposed metal in the compartments. There is a total of approximately 35,000 ft. (10,000 m.) of this control conduit in the station. The sizes of conduit vary from 1 in. up to 1½ in. (25 mm. to 38 mm.). All of the control wiring is made up of multip'e-conductor braided cable, No. 12 (3.3 sq.mm.) being used for all potential and oil-switch control circuits and No. 9 (6.6 sq.mm.) being used for all current transformer secondary circuits. All of this cable has colored tracers







FIGS. 3, 4 AND 5—TYPICAL FEATURES OF THE ELECTRICAL INSTALLATION

Fig. 3—Regulator in position. The concrete curbs together with the regulator compartments which they join form basins of sufficient capacity to hold all the oil in a regulator. The curbs are made of weak concrete (eight-to-one mixture) which can be easily demolished and renewed if it becomes necessary to remove the regulator. All high-voltage connections are placed so far back that it is impossible to come into contact with them even by reaching into the compartments. Fig. 4—Combined water and oil-cooled three-phase transformers. This 13,200 4,500/2,600-volt, 60-cycle transformer is shown from the high-tension side. It is rated at 3,000 kva. when the water-cooling coils are used and 2,200 kva. when operating as a self-cooled unit. Notice rails in floor to facilitate removing transformer for repairs. Fig. 5—4,500-volt outgoing switch compartment. This photograph shows the 4,500-volt outgoing structure on the third floor. The busbars are in compartments formed by the overhead barriers, which are deep enough to conceal the bus.

in the braid of each conductor. This feature eliminates testing and tagging, as a definite code is followed in connecting.

Ample Provision for Station Operating Service

Current for operating the oil switches is derived from a sixty-cell N409 Gould storage battery having a discharge capacity of 160 amp.-hr. at a 20-amp. rate and from two motor-generator sets. These motor-generator sets each consist of a 15-hp., 230-volt induction motor directly connected to a direct-current generator having a rating of 50 amp. at 115-175 volts. The special voltage range enables the battery to be charged directly from one of the sets while the other set furnishes power for the operating bus.

A 230-volt, three-phase, 60-cycle operating bus for supplying service to station auxiliary motors and station lighting is energized from two 75-kva., three-phase, 4,500/230-115-volt General Electric transformers installed on the third floor in the 4,500-volt structure and fed from two different sections of the bus. Either of these transformers is capable of taking care of the entire load. All switches and instruments for all of this auxiliary apparatus are on a vertical panelboard at one end of the operating deck. A reverse-current circuit breaker is so connected in the direct-current operating bus as to disconnect the generator from the battery system in case of failure of 60-cycle voltage and to leave the battery connected to the operating bus.

The vertical switchboards and benchboards provide complete and independent control for each phase of each outgoing and incoming feeder of both voltages. The single exception is that three-pole oil switches are used on the 13,200-volt feeders. The 4,500/2,600-volt system has a permanently grounded neutral. The 13,200-volt system neutral is not grounded, and the general practice is to use only two current transformers, one or two ammeters and a polyphase wattmeter.

Drilling of Holes Made Unnecessary by Use of Inserts

A great deal of time was saved in the electrical construction of this station by providing inserts in the concrete and brick for everything that was to be bolted up; in fact, it was not necessary to drill a single hole or cut away any material to mount any of the equipment.

The 13,200-volt wiring is carried out entirely by the use of ¼-in. x 2-in. (6-mm. x 51-mm.) bare rolled copper bar mounted on busbar supports and run in either brick or soapstone barriers of sufficient depth to give at least 3 in. (75 mm.) clearance between the cell door and the blade of the disconnecting switch mounted in the compartment.

Wherever the bars go through floors or walls a corrugated porcelain bushing is provided which projects 6 in. (15.5 cm.) on each side of the floor or wall. The 4,500-volt circuits from the main transformers to the 4,500-volt bus and the 4,500-volt bus itself are also composed of ¼-in. x 2-in. (6-mm. x 51-mm.) copper mounted in the same manner but built up of two or more laminations.

It is worthy of notice that very liberal aisle space is provided throughout, also that personal danger is lessened by the fact that no matter where a man may be working there is always more than one avenue of escape from the spot.

The incoming and outgoing feeders of both voltages are each protected by three General Electric form IA single-pole wattmeter-type definite minimum time limit overload relays. Incoming cables, on the other hand, are operated in pairs which are protected by differential balanced quick-acting relays operating on 25 per cent current unbalance. The transformers are protected by quick-acting differential relays of plunger type which function only when trouble occurs within the transformer. These differential relays trip out the oil switches on both sides of the transformer and are set to operate as nearly instantaneously as possible.

In all except very severe weather it is expected that the radiation from the transformers and regulators will furnish sufficient heat for comfort within the building. With this in view dampers were installed in the brick chimneys which lead from each of the main transformer compartments to the roof.

Each of the outgoing 4,500/2,600-volt feeders is equipped with standard Westinghouse reclosing relays in connection with the oil switches. These devices consist of a contactor which acts immediately upon the opening of the oil switch on overload and recloses it. A wattmeter-type, time-delay relay whose functions it is to stop the action of the contactor goes into operation at the initial opening of the oil switch and allows the contactor to reclose the oil switch three times at 0.75-second intervals before it stops the operation. This duplicates the company's standard practice in its manually operated stations.

Revision of British Wiring Rules Demanded

ACCORDING to *Beama*, a journal devoted to the interests of British electrical and allied engineering, the wiring rules of the Institution of Electrical Engineers are in urgent need of revision, with the object of prescribing reasonable minimum requirements. It is an open secret, says *Beama*, that a vast number of installations are made in contravention of the rules as they stand. No power exists, except in the case of a few undertakings which have taken powers under special parliamentary acts, to enforce any regulations whatever on the wiring contractor, and if a consumer chooses to pay a low price he can have his work done entirely with foreign cables and accessories of a quality that no British manufacturer dreams of making. The result naturally is the loss of a large volume of trade. A complete revision of the wiring rules has been put in hand by the Institution of Electrical Engineers, and it is hoped that the new rules will form a working basis acceptable alike to authorities, contractors and manufacturers.

AT THE *close of the Civil War a man could plant his feet on the ground of the Constitution and, if he could hold himself there, he was safe. Today all old postulates are denied. There are a vast number of people who think that, after all, the best way is for men to do what seems to be right, and that it is all wrong that we should be limited by so many constitutional provisions, and that there is too much law. Their method is that of the Turkish cadi. The background is the assumption of perfection. The great and pressing need of our country is the preservation of our institutions.* —ELIHU ROOT.

Standardized Maintenance in Power Plants—II*

Maintenance Systems Show Wide Variation Due to Operating Condition—High Load Factor Increases Difficulties of Maintenance Work — Periodic Inspection and Record Keeping Are Important

By A. B. STITZER
Chief Engineer Republic Engineers, Inc., New York City

IN THE development of a system of maintenance for central stations it is not always possible to carry out a plan in elaborate detail owing to peculiar operating conditions involved. There is always a possibility, however, of improving conditions by a definite study of the subject and by evolving a plan which will be flexible enough to provide for unusual factors. The following data, collected from representative companies, will show the variation of plans used for maintenance work:

COMPANY No. 1.—This company has a maintenance system which, while not very much standardized, is carried out to the greatest extent possible under the operating conditions. At the present time the company's main plant is very heavily loaded, frequently maintaining daily load factors as high as 70 per cent to 75 per cent. In consequence of this it is practically impossible to take any of its generating units out of service for any length of time for the purpose of repair. It is equally impossible for the company to arrange any stated time for taking its boilers off the line for inspection or overhauling. This condition partakes of an emergency nature and will be relieved as soon as a new plant, now in process of construction, is in operation.

An attempt is made to take a boiler off the line for cleaning and overhauling after five weeks under steam. Frequently this is impossible and the boiler is allowed to remain in service until the first convenient repair period, at which time it is opened up and such repairs as are necessary are made and the heating surface is cleaned. In the meantime any urgent repairs, such as stoker breakdowns and furnace repairs, are made at periods when the load is lightest and the boiler can be spared from the line for a sufficient length of time to do the work.

VERY EFFECTIVE WORK ORDER SYSTEM

It is the intention of this company to make up a standard schedule and follow it out as soon as conditions will permit. The present system of handling maintenance work and keeping records of it is excellent. When a piece of apparatus is to be overhauled or inspected a work order is issued from the office of the chief engineer or plant superintendent stating just what is to be done to a particular piece of apparatus and the time at which it shall be done. Two days before the work is to be performed the work order is turned over to the foreman in charge of that part of the station in which the apparatus is located. Upon receipt of the order the foreman investigates the condition and makes certain that he has the proper material and spare parts on hand for the work and arranges with the operating force for the release of the specified piece of apparatus from service at the stated time. As soon as the work has been completed the apparatus is turned over to the operators, ready for use. A statement is made on the work order that the work has been satisfactorily performed and inspected and the work order is then returned to the chief engineer's office, where it is filed in a permanent record file.

Form 631. 1000-7-15

BOILER REPAIR REPORT, POWER STATION, (MURPHY)

BOILER No. ..... Taken Off Line at ..... A. M. / P. M. ..... 191...

BOILER TAKEN OFF Account of .....

CAPS: Took Off ..... Front Caps, ... Rear Caps. Put On ..... New Caps, ... Nuts, ... Bolts, ... Clamps.

TUBES: Washed Out ..... Upper / Lower Rows, Scaled ..... Tubes / Lower Rows. Put In ..... New Tubes, as Follows:

Scraped Tubes In ..... Brushed Lower Side of Drums Yes. / No.

ARCH: Built New / Repaired Old. Used ..... New ..... Bricks and ..... Old Bricks.

BRIDGE WALL: Used ..... New Bricks and ..... Old Bricks.

BAFFLES: Put In ..... Flame Plates, ... Baffle Bricks, ... Tube Bricks.

DRUMS { STEAM: Opened Up A / B / C. Washed Out A / B / C. Scaled A / B / C.
MUD: Cleaned Yes. / No.

BLOW-OFF VALVES: Took Off Tops A / B / C. Put New Discs In A / B / C. Packed A / B / C.

COMBUSTION CHAMBER: Cleaned Out Yes. / No.

PACKED VALVES .....

MADE JOINTS ON .....

STOCKERS: Put In ..... F / C / B Stocker Boxes, ... Reaper Bars, ... R. M. / L. M. Arch Plates, ... M. / S. Grate Bars ..... Rocker Bars, ... Clinker Bars. Other Parts .....

OTHER REPAIRS: .....

BOILER ON LINE AND O. K. at ..... A. M. / P. M. ..... Boiler Off Line ..... Days ..... Hours.

NOTE.—For Superheater tubes, 8th short tube from left to right would be "8-S. S." 8th long tube "8-S. L."

Reported by .....

1 .....
2 .....
3 .....
4 .....
5 .....
6 .....
7 .....
8 .....

Example: The 8th tube counting from left to right on the 3d row of tubes from the bottom would be "C 8".

FIG. 1—FORM USED FOR BOILER INSPECTION AND CLEANING

In case of an emergency where there is not sufficient time to obtain a regular work order in advance any repairs on account of accidents to apparatus or other causes which require immediate attention may be made at once, but a work order covering the job must be obtained as soon as possible. The work order system is further simplified by dividing the machinery in the power station into a limited number of main groups so that all machinery comes under a certain group and the maintenance of any particular machine can be carried on in such order as is consistent with the arrangement of the machinery in its group.

In the boiler room the company has two or three types of boilers and as many types of stokers. There is a printed form, similar to that shown in Fig. 1, covering each particular type of boiler and stoker, which the boiler-room foreman must fill in each time a boiler is taken off for cleaning and inspection. The forms cover practically all parts of the boilers and when prop-

*Presented before station operating committee, Ohio Electric Light Association. See ELECTRICAL WORLD, March 27, page 718, for Part I.

erly filled in show the condition of the entire boiler and its auxiliaries. The forms are filed in the maintenance file as a permanent record of work performed on the various boilers.

Elaborate Maintenance Schedule

COMPANY No. 2.—Here an elaborate maintenance schedule is in operation, the plan of the system being as follows:

Card Index of All Apparatus.—Each piece of equipment has a separate card specifying the group to which it belongs and its number. This card shows for one year the periodic dates at which the apparatus should be taken out of service for overhauling.

Monthly Card Index.—A card for each month indicates what apparatus is to be overhauled during the month and on what date the overhauling should take place. This file is arranged for five consecutive years.

Maintenance Record Books.—There are four books, one for each department (boiler room, electrical, etc.), in which every machine is recorded. Numbered spaces are provided opposite the name of the apparatus and show the work to be performed. For example, on the page covering No. 1 fan engine there would appear: Item 1—thorough overhaul of all bearings; item 2—inspection of pistons, etc.

Foremen's Lists.—The foreman in charge of each maintenance gang is given a list of the machinery in his department which is to be overhauled on a given date, the numbers of the items which are to receive attention being included in each particular case. This list is given to each foreman a week in advance of the time at which the work is to be done. It is then his duty to check up the repairs ordered and see if they are correct and make such additions as appear advisable; also to see that all necessary material is on hand for the work.

Reports.—At the scheduled time each machine is taken out of service, inspected, overhauled and put in first-class condition. The foreman then makes a written report of the condition of the machine and of the repairs made, which report is turned into the office and put into the maintenance record book.

Follow-Up.—If for any reason it becomes impossible to overhaul a machine on its regular date, it is put into a follow-up schedule. The time of inspection is then postponed for one week or as much longer as necessity requires.

This system, even though quite involved, is undoubtedly a good one. Under the actual working conditions of this particular plant, however, it becomes extremely difficult to follow out. In the first place, there is not enough spare capacity installed to work out the schedule, and, furthermore, there are not enough men available to carry out the work as scheduled. However, neither fault is due to the schedule.

No Schedule Followed

COMPANY No. 3.—This company does not have a schedule for the maintenance of its apparatus. The practice has been to handle emergency repairs by taking the faulty apparatus off the line, repairing it and putting it back in service as soon as possible. It has also been the policy to anticipate as much as possible the maintenance work on various pieces of machinery and to arrange for such work by a system of work orders originating in the master mechanic's office. These work orders provide for the work to be done and for men to do the work, but the only record of such work is the entry made in the station log. An endeavor is made to inspect one main generating unit and its auxiliaries each Sunday and to do as much overhauling as possible.

In the boiler room there is sufficient capacity to allow one boiler off for cleaning and overhaul at all times. There is no schedule specifying any particular time at which a certain boiler shall be taken off for maintenance, but the selection of the next boiler to be worked upon is left to the judgment of the boiler-room foreman. The work-order system applies in the boiler room only in so far as the nature of the work to be done requires the services of the master mechanic's crew, boiler-room maintenance being handled almost entirely by the men under the boiler-room foreman.

Records of the maintenance work are kept on printed forms which show the repairs made to all boilers and auxiliaries. The number of tubes turbined, replaced or rerolled and the first-row tubes on which bags and blisters have been driven back are recorded on a special diagrammatic form which shows the tube sheets of the various types of boilers.

COMPANY No. 4.—The general policy here is alert watchfulness rather than completely standardized maintenance. The operating force is trained to detect the least irregularity by variations in sound while equipment is in operation. The trouble is investigated as soon as practicable and can usually be eliminated in time to prevent serious damage.

The inspection of boilers is based chiefly on a record of hours' use and the rate of driving. After every 2,000 hours at rated capacity the boilers are thoroughly cleaned and as many rows of tubes turbined as is found necessary, beginning, of course, at the lower rows and extending upward until comparatively little scale is found. An endeavor is made to give each boiler a complete overhauling once a year. Furnaces, baffles, bridge walls, headers, tubes, drums, etc., are all put in first-class condition.

Turbine casings are lifted once yearly and a thorough inspection made. There is no periodic inspection on auxiliaries or electrical rotative apparatus. They are watched closely from day to day, and any variations in sound or behavior are immediately reported.

Frequency of Inspecting Electrical Equipment

All oil switches and transformers are drained of oil and refilled once a year. The oil in switches is sampled about once every three months. All large oil switches are tested for operating condition by being thrown in and out during every week-end light-load period. The operation of each switch is carefully watched and any trouble which can thus be detected is immediately remedied. There is no other maintenance on these switches unless one happens to open under load, in which case the switch is immediately dismantled and overhauled. Outdoor switches are arranged so that the cans may be dropped from time to time for the inspection of mechanism and contacts. Small hand-operated oil switches are regularly inspected every three months.

When emergency repairs are made on any of the equipment coming under a standard schedule of maintenance, the next inspection is moved ahead one period from the date of the completed repairs.

One rather novel idea instituted by this company is the method of record keeping. Attached to every piece of apparatus is a tag which contains all data pertaining to the last inspection and the initials of the man responsible for the work. It is the duty of the operating force to report weekly on the observed tag record. These reports are a guide for the engineer in charge as to just what equipment is nearing the time when it will prob-

ably need inspection, and he can thus lay his plans for taking such apparatus out of service.

No file card record of inspection is kept except that covering the cost data. When repairs are to be made a rough pencil estimate is made out in duplicate in the office of the station superintendent. One copy is placed in the station file and the other transmitted to the auditing department with an application for a work order. The auditor then issues a numbered work order authorizing the specified repairs. A detailed daily record is kept of labor and material charged to this work order and this record is turned in to the auditing department. When the job is completed, the auditing department makes out a neatly typewritten card giving all details of the work done and its cost and then transmits the card to the station superintendent's office, where it replaces the original pencil estimate in the station file. In an emergency it is, of course, necessary to do the work first and obtain the work order afterward, but this constitutes the only exception to the rule.

COMPANY NO. 5.—After a number of years of experimentation, this company has developed an elaborate and yet remarkably efficient system of standardized maintenance. The cost last year was approximately 15 per cent of the total operating cost and included periodic inspections, file-card records, repairs and renewals. The "periodic schedule" follows:

Apparatus.	*Interval Between Inspections.*
Boilers	Six months
Stokers	Five weeks
Blowers	One week
Feed pumps	Three months
Turbines	One year
Circulating pumps	Two weeks
Other auxiliaries	Two months
Generators	Three months
Rotaries and motor-generator sets	Three months
Exciters, boosters and balancers	Four months
Switchboard instruments	One year
Relays	Six months
Oil switches, partial inspection	One week
Oil switches, complete inspection	One year
Batteries, pilot cells tested	One day
Batteries, all cells tested	One week
Batteries, complete inspection	One year

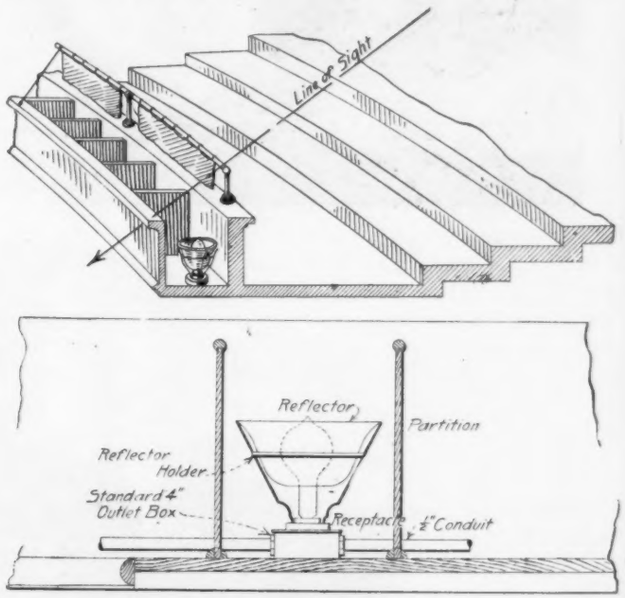
COMPANY NO. 6.—No definite system of maintenance is in force. The stations are carrying a load so near the limit of their capacity that a standardized schedule is out of the question. Equipment cannot be taken out of service long enough to permit a thorough inspection. Emergency repairs are made during periods of light load and on Sundays. As there is evidently very little prospect of increasing load this company would have difficulty in financing the additional equipment required for a standardized schedule of inspection.

IT HAS *never proved to be humanly possible to regulate prices through the instrumentality of the central government with such delicacy and accuracy of adjustment as to enable the ship of state to navigate successfully between Scylla and Charybdis. As a temporary expedient, government control of prices is sometimes imperative, but as a permanent method, as a substitute for the economic law of supply and demand, history and our own recent experience demonstrate clearly that government regulation of prices is foredoomed to failure.*—PHILIP CABOT.

Theater Lights Concealed on Balcony and in Cornices

THE elimination of pendent ceiling fixtures has been accomplished in the lighting installations of the American Theater, Chicago, without losing any of the desired lighting effects. A lighting trough was built on the front of the balcony below the rail and barriers were placed between each lighting unit, as shown in the illustration. In the stair walls leading into the balcony from the second-floor lobby an arrangement similar to this was used.

Viewing the balcony from near the stage, it is not at once apparent that the projecting compartment has been added. No lamps are visible to any one seated in the balcony, and only the extreme ends of the lighting compartment on the front of the balcony may be seen.



THEATER LIGHTING WITHOUT PENDENT FIXTURES

The upper sketch shows the projection which was built onto the front of the balcony and the arrangement of the lamps and reflector equipment in compartments. The lower sketch is a section of one of the compartments.

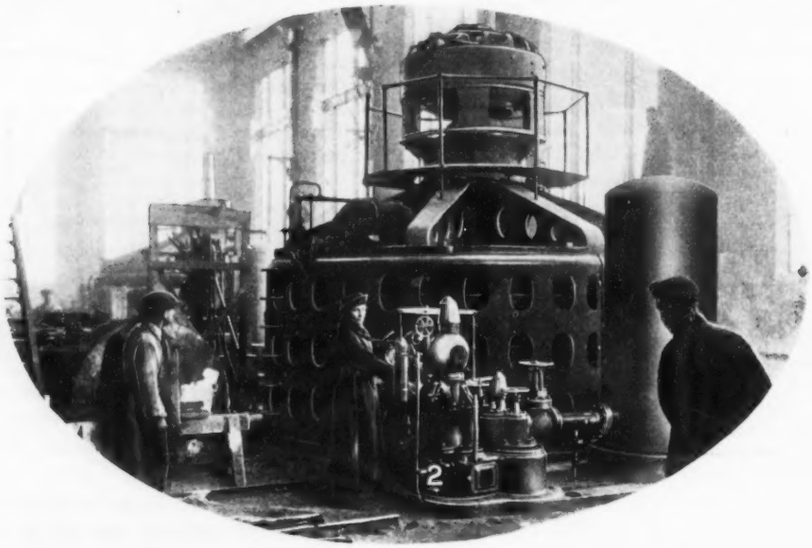
Another arrangement of concealed lamps and reflectors which is suitable for some theaters is the cornice type of lighting. This system was installed in the Pantheon Moving Picture Theater, Chicago, which is built in the form of a Pompeian temple. In order to get desired color combinations four series of lamps and reflectors are employed—one for white lighting and one for each of the primary colors, red, yellow and blue. Color screens of glass are mounted above the openings of the lighting units and a system of dimmers is provided. The accompanying table gives the data on this installation.

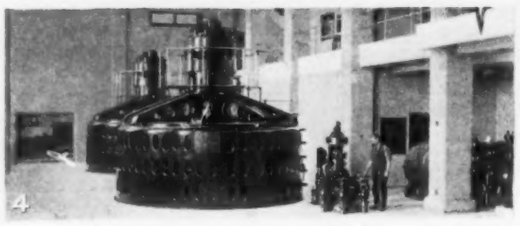
TABLE OF LIGHTING DATA FROM PANTHEON THEATER AUDITORIUM

Size of room	85 ft. x 140 ft.
Floor area	11,900 sq.ft.
Height of ceiling	45 ft.
Number of reflector units in coves	256
Kind of reflector used	X-ray No. 610
One lamp in each unit	200-watt Mazda C
Wattage consumed (each color)	1.08 watts per sq.ft.

The data on these two installations was contained in a paper by Augustus D. Curtis and J. L. Stair of Chicago, read before the recent convention of the Illuminating Engineering Society.

New Water-Power Plants in New England





(1) Dam of the Stevenson plant of the Connecticut Light & Power Company on which W. S. Murray was construction engineer, completed in 1919. (2) One of the alternators in the Stevenson plant. The small pictures (3) and (4) show the new plant of the Rumford Falls (Maine) Power Company. The combined capacities now aggregate 24,000 kw. The hydro-electric plant shown (5), with the high water in the tail race, is the 2,500-kva. "tunnel" plant of the Eastern Connecticut Power Company, built by the Harry M. Hope Engineering Company, Boston, Mass.

Iron and Steel Wire for Transmission

Analysis of Available Data Shows that Cheaper Grades of Iron and Steel Conductors Have the Advantage of Lower Permeability—Greatest Usefulness Is Found Where Load Is Light and Scattered

By R. W. GODDARD

Professor of Electrical Engineering New Mexico College of Agriculture and Mechanical Arts

IRON-WIRE lines prove most advantageous in cases where the power requirements are small and steady and where the load is somewhat scattered, requiring high-voltage transmission, and where the cost of construction and maintenance must be reduced to a minimum. Fortunately the effects due to the higher permeability of iron are minimized in the cheaper grades of iron and steel.

In making comparisons between two possible methods of constructing a transmission line, it is usual to consider net returns on the investments required, all other factors being made as nearly equal as possible. To make such a comparison, it is then necessary to be able to pre-determine the characteristics of each line in order to balance them.

For copper lines, all the necessary data as to the actual performance of any prospective line is readily obtainable. But for iron-wire lines little information is at hand. What is available seems inconsistent to such an extent as to make the average engineer skeptical as to the practicability of using it with any degree of success in pre-determining the operating characteristics of a proposed line. Such doubt tends to make the courageous ones that do try it use such high factors of safety that the full advantages of the iron over the copper are often lost. It is the purpose of this paper to review briefly the causes for differences between the operating characteristics of iron and copper lines that they may be better understood.

For copper, the resistance is a function of the length area, purity and temperature. Within commercial limits it is constant over a large current range. It is practically the same for alternating current as for direct for the ordinary frequencies, and always assumed constant.

Skin Effect and Related Problem

For iron, the resistance is quite different for alternating and direct currents. This is due to the fact that the wire is of magnetic material, and an alternating current sets up in it an appreciable alternating field, thus causing potentials to be generated within the conductor. These increase from the outside toward the center of the cross section. Now this potential is opposed to the current flow and therefore, since the current takes the path of least resistance, it will distribute itself in reverse proportion to the potential, or the current density will be a minimum in the center and a maximum on the surface. This phenomenon is known as the skin effect. The practical result of skin effect is a reduction of the available conducting area of the wire.

In addition to the skin effect there is in iron wires carrying alternating currents a hysteresis loss and an eddy current loss in iron wire greatly in excess of that found in copper due to the increased magnetic field in the magnetic material. Since all these things depend in complicated degree upon the same factors, *i.e.*, current, frequency, wire diameter, permeability and conductivity, and produce the same practical effect, *i.e.*, absorb power to heat the wire, it is generally conceded there is no need to separate them and so they are grouped together into a single factor whose value is equal to the power lost in the line divided by the current squared. This is of the nature of a resistance and so it is termed the effective alternating current resistance and is measured in ohms. The problem is then to discover the law of variation of this effective resistance with the different factors affecting it.

This subject has been studied by some from the theoretical standpoint and by others from the tabulation of actual test data. In all cases the results are expressed as a ratio of the effective resistance to the direct current resistance, or in other words a factor is deduced which multiplied by the direct current resistance would give the effective alternating current resistance.

Steinmetz* gives this relation as follows:

$$\frac{R}{R_o} = \frac{d}{2} \times \frac{\sqrt{\frac{\mu f}{\rho}}}{5030}$$

in which R = effective a.-c. resistance; R_o = d.-c. resistance; d = diameter of wire in cm; μ = permeability of material; ρ = resistivity of material in microhms per cu. cm; f = frequency.

Lord Rayleigh† gives the following formula, the symbols being the same as in the above except ρ which is in absolute electromagnetic units (microhms per cu. cm. $\times$ 1000).

$$\frac{R}{R_o} = \frac{\pi d}{2} \sqrt{\frac{\mu f}{\rho}} + \frac{1}{4}$$

Both of the above formulae are arrived at from a theoretical consideration of the problem and do not agree very well. This discrepancy is probably due to a difference of assumptions upon which the reasoning is based or a lack of proper consideration of some of the many factors which actually affect the results.

Actual test data are at the present time somewhat limited and also lack uniformity. This is probably due to the variations in quality of wire used and the different methods of testing and arriving at the conclusions.

Probably the most complete table published to date is one by Messrs. Oakes and Sahm of the Bureau of Standards, Washington, D. C., and published in the Electrical World for July 27, 1918.

As an illustration of the difference between the effective and ohmic resistance of a line, the following data was collected for a No. 6 B. W. G. iron wire:

By Steinmetz's formula using $\mu = 500$, $\rho = 12{,}200$, gives a ratio R/R_o at 60 cycles of 2.5,

*Transient Electric Phenomena and Oscillations, p. 376-317.

†Radio Telegraphy & Telephony, Fleming, p. 15. Principles of Wireless Telegraphy, Pierce, p. 237-238.

Similarly by Rayleigh's formula, using $\mu = 500$, $\rho = 12{,}200$, gives a ratio R/R_o at 60 cycles of 1.52.

Actual test on a No. 6 B. W. G., B. B. grade-wire line of the Pacific Gas & Electric Company at San Francisco, operating three-phase, 60 cycle, at 60,000 volts, gave the following results per mile of wire, considering wire to neutral:

Amps.	D.C. Res.	A.C. Res.	R/R°	React. to Neutral	Imped. to Neutral
7.2	10.45	18.7	1.8	9.50	20.95
12.2	10.45	20.8	2.0	9.65	22.9
22.3	10.45	20.1	1.9	10.05	22.4

A test by the General Electric Company, on a three-phase No. 6 B. B. grade line spaced at the points of an 84-in. (2.13-m.) triangle gave per mile of wire to neutral:

7.0	10.6	20.0	1.93	10.0	22.5
13.7	10.6	21.0	1.98	10.2	23.5
22.0	10.6	21.0	1.98	10.5	23.5

Based upon the table published by Messrs. Oakes and Sahm of the Bureau of Standards for a No. 6 B. W. G., E. B. B. grade iron wire the constants per mile of wire to neutral are:

5.0	10.5	17.4	1.66	....	.....
7.0	10.5	19.7	1.88	....	.....
13.0	10.5	20.0	1.90	....	.....

A scrutiny of these values shows that the calculated values are high and low respectively, but that their average is closely that obtained by actual tests, all of which seem to agree very well among themselves. The change of effective resistance with current is due to the change of permeability of the wire with the change of flux density. This is well illustrated by the fact that after the iron becomes saturated the effective resistance ceases to increase and may even decrease. This effect is more noticeable with wires of high permeability than for the poorer grades with low permeability. Because of this fact and the lessened amount of skin effect the poorer grades of iron or the steel wires make better lines than the purer and more expensive wires.

WHY CHEAPER GRADES OF STEEL SHOULD BE USED

The reactance of a line is made up of three components, the capacity reactance usually considered separately from the others and the internal and external inductive reactance.

The internal reactance is due to the self-induction of the wire, caused by the cutting of the wire by the flux created by its own current. For copper wire this factor is so small as to be negligible and is seldom considered. But in the iron wire the flux is so greatly augmented because of its magnetic properties as to make the internal reactance a sizable factor. A table giving internal reactance of several grades of steel wire for various currents by Oakes and Sahm was published in the ELECTRICAL WORLD, July 27, 1918. The values are arrived at by substracting from the effective reactance of the line the external reactance as calculated by the usual formula for copper transmission lines.

For purposes of comparison, the following specific values of internal reactance, based upon the data of Oakes and Sahm, have been worked out below for $\frac{5}{16}$-in. (7.9-mm.) 7-strand cable in ohms per mile of wire:

INTERNAL REACTANCE

Material	Current in Amperes 1	5	10	15
E. B. B.	0.40	1.75	2.50	2.25
B. B.	1.186	0.93	1.66	2.19
Ordinary steel	0.18	0.68	1.20	1.72
Siemens-Martin	0.04	0.20	0.40	0.60

A study of this table brings out some curious facts. The internal reactance is from 4 to 10 times greater for an E. B. B. $\frac{5}{16}$-in. (7.9-mm.) 7-strand cable than a Siemens-Martin one of corresponding size; from $2\frac{1}{2}$ to $4\frac{3}{8}$ times for a B. B. cable; and from 2 to $4\frac{1}{2}$ times for ordinary steel. At low current densities the effect of the material is most noticeable and is less than half as marked for the high current densities. The variation of internal reactance with change of current is greater for iron wires and less for the steel wire.

For comparing the effect of wire diameters on internal reactance the following tabulations were made:

Size B. W. G.	Current Density Circ.mil. 1 Amp. 5,000	7,500	10,000	12,500	15,000	20,000
	Actual Current in Conductor					
6	8.24	5.5	4.12	3.3	2.75	2.06
4	11.32	7.5	5.66	4.5	3.78	2.83
	Internal Reactance for Above Current Densities					
6	12.94	10.75	10.32	9.84	9.31	8.76
4	8.31	7.40	6.96	6.68	6.50	6.28
	Per Cent. Reduction in Internal Reactance of Larger Wire					
F 36	32	30	32	30	.....	27.5

From this it is seen that the larger wire will carry more current in proportion to its area than a smaller one with the same internal reactance, or have a smaller reactance for the same current density.

The external reactance is caused by the self-inductance of the wires. Its value is a function of the spacing and diameter of the wires. For iron and steel lines it is calculated from the same formulae as are used for copper lines as stated above.

The capacity reactance of an iron line is the same as for one of copper, and is figured in the same way.

It is well to remember at this point that an iron or steel line having the same power losses and regulations as a corresponding copper line has conductors of considerably larger diameter and therefore has greater capacity. Usually this is an advantage, as the capacity current neutralizes a greater amount of inductive current of the ordinary load, thus improving the power factor of the line and consequently the regulation and power losses. With extremely long lines the preponderance of capacity current due to the great capacity might prove troublesome.

USEFULNESS OF IRON WIRE IN TRANSMISSION LINES

In conclusion it might be well to enumerate some of the vital points to be considered in comparing an iron substitution for copper in transmission-line construction.

The effective resistance of iron wire is approximately $1\frac{1}{4}$ to 3 times and the effective reactance from 5 to 12 times greater than for copper under the best conditions. Skin effect is the chief cause of increased resistance due to alternating currents. This effect varies nearly directly with the radius of wire used. On this account small diameter or stranded cables should be used. For sizes below No. 12 B. W. G., the skin effect is nearly negligible. The resistance also increases rapidly, with the frequency varying about as the square root.

The permeability of the iron is an important factor to be considered. It affects both the skin effect and the internal reactance. On this account cheaper and poorer grades of iron and steel wires make better lines than the more expensive purer grades.

The internal reactance is considerably affected by the current density. To maintain regulation with reasonable power losses it is necessary that the current density be not much in excess of 1 ampere per 10,000 circular mils of conductor area.

Iron and steel are much stronger than copper, making its use in smaller sizes practical for lines requiring only small currents. Also the allowable spacing of poles can be increased. Experience has proven that the steel line cannot be pulled up too tightly, linear elongation within the elastic limit being greater than the temperature contraction. This means sags may practically be forgotten, allowing shorter poles and quicker and cheaper construction. One line* built with poles 412 ft. (125 m.) apart and strung with No. 6 iron wire drawn as tightly as possible to pull it without breaking has withstood wind and sleet where surrounding copper lines have given way.

The life of iron and steel is shorter than that of copper, being from two to twenty-five years, depending upon the presence of moisture in the air, proximity of salt air, soft coal smoke, etc.

The power loss and consequent heating of iron wires are proportional to the effective resistance and not to the d.-c. resistance as compared with copper lines.

The possibility of using stranded guy wire for extension lines into new territory, later replacing it with copper when the service demands it, the iron then being turned to its original duty of guying on further lines, has attracted more than one public utility to the use of iron transmissions.

Optimistic View of Turbine Development

Past Turbine Troubles Were Due Chiefly to Maufacturing Conditions During War—Turbines Can Be Made Most Reliable Prime Mover Built

BY RICHARD H. RICE†
Manager Lynn Works, General Electric Company

IN THE old days of the reciprocating engine there were difficulties and troubles which at the time were thought to be very serious. Today those difficulties look very small in the light of the magnitude of the present power-station industry, the large number and large size of units involved and the greater necessity of absolutely continuous service. As in the old days, difficulties have been experienced with new types of prime movers. However, it must be remembered that there is no instance of a similar art developing with such rapidity. In such a rapid development it must be expected that the safety line will be passed occasionally and the danger zone penetrated a little too far in a desire to achieve the final form of apparatus quickly. Certainly no apologies are necessary for striving after high efficiency in the face of seven-dollar coal and the high cost of all materials which make up a plant.

The great change in manufacturing conditions during the war had a considerable effect on turbine development. On account of the unprecedented demand for steel the manufacturers gave more attention to tonnage output than to quality. Still, that was a period when new materials or materials of greater strength and different qualities were wanted for turbines and when research or careful analysis was most needed. Then, too, the character of labor changed for the worse and workmanship was uncertain.

Co-operation between turbine operators and designers is one of the best ways to avoid unsatisfactory development. A very good measure of this co-operation has existed in the last year. In those conferences all the cards have been laid on the table on both sides. This must always be done, because designers must know the troubles in order to cure them. It was one of my troubles as a turbine designer that I could not get close enough communication with the operators. As a matter of fact, operators do not "open up" unless they have serious trouble.

I have had occasion to study the question of heat treatment a great deal in the last ten or fifteen years. Many steel experts engaged in the manufacture of steel and in its study from a more theoretical viewpoint were consulted, but there were great differences of opinion. As a result the turbine manufacturers had to study those problems for themselves. In our plant at Lynn we tested out the methods advised by steel experts and developed treatments of our own. I can say for our works at Lynn, with the progress of which I am quite familiar, that we do not feel any uncertainty or any doubt in the use of heat treatments; but we must be sure that the heat treatment is followed in accordance with our specifications and that the treatment covers the entire piece. Sometimes we have had difficulty because the heat treatment has been localized. Sometimes we have had trouble because when we thought we were getting heat treatment we were not getting quite that. That trouble has been due to the fact that steel manufacturers have been under great pressure and were not able to supervise their work during war times and during reconstruction days with the thoroughness that they exercised before the war.

All the difficulties cited have to do with the reliability of operation of our machines, but I am certain that the difficulties are of a temporary nature and that they will be overcome in a reasonable period. Since periods of uncertainty and difficulty have existed during the development of other prime movers, but have always been followed by successful achievement, I believe that the turbine can be made to be the most reliable prime mover which has ever been built.

We have allowed turbine size to be pushed up quite rapidly, perhaps too rapidly; but that is a co-operative problem. The operators have wanted large machines and we have done our best to give them what they wanted. Certainly, it is not unreasonable to suppose that a turbine casing weighing several hundred thousand pounds with its complete equipment should take some little period to warm up. It ought to be put into operation rather gradually.

I look forward to a continued development of the turbine. Perhaps there will not be a development of its present form to much greater efficiency, but I believe that in combination with other methods we shall go forward along the lines of economy.

*Sag calculation for iron wire lines, ELECTRICAL WORLD, August 3, 1918.

†Abstract from an address by Mr. Rice before the Boston Sections of the A. I. E. E. and A. S. M. E.

Correcting Synchronous-Motor V-Curves

Harmonics in the Line Voltage Frequently Produce Discrepancies in the Characteristic Curves of Synchronous Motors—Simple Analysis Is Offered for Correcting Erroneous Results

By JACOB R. COLLINS

MOST engineers who make use of V-curves of synchronous motors have encountered difficulties in the failure of measuring instruments to indicate reasonable power factors at the region of the curve where the armature current approaches its minimum value. Discrepancies of this character cast doubt upon the whole data. The analysis offered in this paper makes it possible to account for irregular data due to harmonics in the wave form of voltage at the synchronous motor. The method should also prove useful in other measurements when current or voltage are not sinusoidal.

The use of vectors in one plane to represent alternating electromotive forces and currents is based on the assumption that these qualities are simple sine functions of the time and of the same frequency. If the currents are not simple sine functions of the time, but are made up of components of different frequencies, vectors in one plane no longer truly represent these currents. It has been shown by Prof. F. Bedell* that the components of higher frequency may be represented by a vector at right angles to the plane containing the vectors of fundamental frequency.

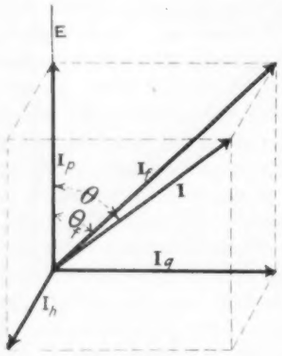


FIG. 1—COMPONENTS OF A CURRENT WITH A PRONOUNCED HARMONIC

The vector I (Fig. 1), representing the total current in a circuit, is then the resultant of the vector I_f, which represents the current of fundamental frequency, and the vector I_h, which represents the currents of all the higher frequencies combined. Since these components are at right angles to one another we have:

$$I^2 = I_f^2 + I_h^2 \qquad (1)$$

The current I_f of fundamental frequency may, in the usual manner, be considered as made up of the two components, both in the plane of fundamental frequency, namely, the power component I_p, in phase with the impressed electromotive force, and the reactive component I_q, in quadrature thereto. Since I_p and I_q are mutually at right angles,

$$I_f^2 = I_q^2 + I_p^2$$

and

$$I^2 = I_h^2 + I_q^2 + I_p^2 \qquad (2)$$

These relations are made clear by Fig. 1.

In ordinary practice the quantities measured are the impressed electromotive force E, the current I and the power W. These quantities are measured by voltmeter, ammeter and wattmeter respectively. Since only the component I_p represents power, we have directly

$$I_p = W/E.$$

Even when the current I_f of fundamental frequency is in phase with the impressed electromotive force, namely, when $I_q = 0$, the total current I contains a reactive component I_h which throws I out of phase with E (hence out of the plane of fundamental frequency), so that the power factor is not unity. In this case

$$I^2 = I_h^2 + I_p^2 = I_h^2 + (W/E)^2 \qquad (3)$$

Since I, W and E can be measured, this expression enables us to calculate I_h for this special case. If for other phase relations between I_f and E, I_h should remain constant or practically so, the value of I_f could be determined from the readings of E, W and I, for, from equation (1),

$$I_f^2 = I^2 - I_h^2; \qquad (4)$$

$$I_q^2 = I_f^2 - I_p^2 = I_f^2 - (W/E)^2, \qquad (5)$$

so that a complete representation, as in Fig. 1, could be made.

The writer has made an application of this method in the case of the V-curves of a synchronous motor, which show the variation of armature current with field current. At constant load such a curve shows a minimum value of the armature current when the component current I_f of fundamental frequency is in phase with the impressed electromotive force. For field currents larger or smaller than this value the armature current increases and the phase angle between the current and impressed electromotive force increases.

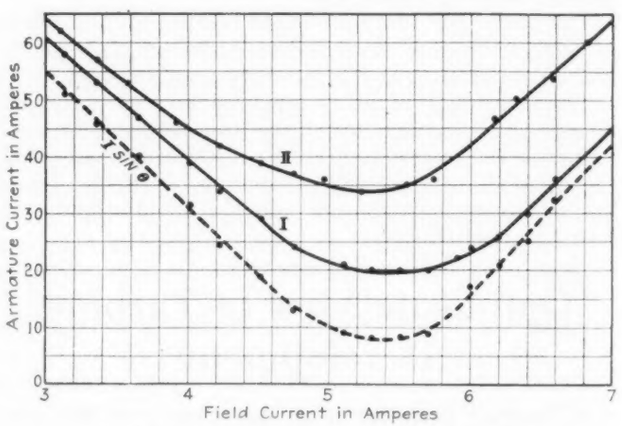


FIG. 2—V-CURVES OF A SYNCHRONOUS MOTOR (I) RUNNING LIGHT, (II) WITH LOAD

If the current flowing is not one of a single frequency, the product of the impressed electromotive force and minimum armature current will be greater than the reading of the wattmeter. In this case the ratio of the wattmeter reading to the impressed electromotive force gives the value of the component current of fundamental frequency. Hence by means of equation (3) the component current of higher frequency is readily computed for this particular value of the field current.

This component current of higher frequency may be due (a) to the deviation of the impressed electromotive force from a simple sine wave, (b) to the devia-

*See *Trans. A. I. E. E.*, Vol. XXV, 1906, page 685.

tion of the counter electromotive force of the motor from a simple sine wave, or (c) to both effects together. In either of the last cases the current of the higher frequency would vary with the field excitation of the motor, but since the armature current increases rapidly with the change of field excitation, the effect of the higher frequency current is appreciable only when the field current has a value near that for minimum armature current.

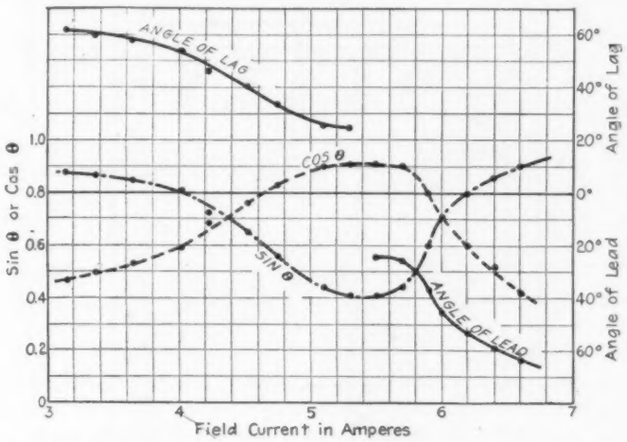


FIG. 3—DISCREPANCIES IN CHARACTERISTICS OF MOTOR DUE TO NEGLECTING PRONOUNCED HARMONIC

To illustrate, the V-curves for a synchronous motor are plotted first in the usual manner (without regard to the component current of higher frequency) and, second, in a manner suggested by Professor Bedell, which takes account of the component of higher frequency in the way just described. The curves *I* and *II* are plotted from observed values of armatures and field current at two different loads. Curve *I* is taken at practically no load, the motor being belted to a generator which is running idle. Since the total armature current is small at high power factors, the current of higher frequency will be a considerable fraction of the total current when the power factor is near unity. From the values of *I* taken from curve *I* the curves in Fig. 3 are obtained.

The phase angle θ between impressed electromotive force *E* and total current *I* is obtained by the relation

$$\theta = \cos (W/EI).$$

θ, sin θ and cos θ (power factor) are plotted in Fig. 3 against the field current. For a sine current the minimum value of sin θ should be zero, the maximum value of cos θ should be unity and the minimum value of the phase angle should be zero. From Fig. 3 it may be seen that the minimum value of sin θ is 0.41, the maximum value of cos θ is 0.91, while the curve for the phase angle θ is discontinuous in changing from angle of lag to angle of lead, the minimum value being 24.5 deg.

The minimum armature current is 19.5 amp.hr. The load in this case *I* is 3.95 kw., and the impressed electromotive force 220 volts. Consequently from equation (3) we have as the value of the current of higher frequency at this field current:

$$I_h = \sqrt{I^2 (W/E)^2} = \sqrt{\ldots (19.5)^2 - (3950)2/220} = 7.5 \text{ amp.}$$

Using the value of I_h as constant for all values of field excitation, I_f was calculated by means of equation (4), and the phase angle between I_f and *E* calculated by means of the expression

$$\Theta_f = \cos (W/E)/I_f$$

These values of θ_f, cos θ_f and sin θ_f are plotted in Fig. 4 against the field current. It is seen that the phase angle between I_f and *E* now changes continuously from the angle of lag to an angle of lead as the field current is increased, and not discontinuously as before in Fig. 3. Also cos θ_f has the maximum value unity and sin θ has the minimum value zero. These curves therefore are seen to represent the phase relations between the impressed electromotive force and current I_f of fundamental frequency more accurately than do the curves of Fig. 3.

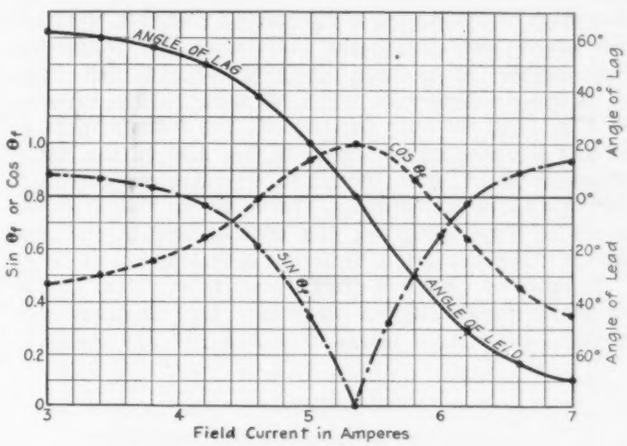


FIG. 4—ANALYSIS MADE BY THE AUTHOR GIVES REASONABLE CURVES

Transformer Connectors Which Eliminate Mistakes

Connecting Bars Between Buses and Transformers Are Removable and Cannot Be Placed in Wrong Position

BY M. M. SAMUELS
New York, N. Y.

WHERE there is only a single bank of transformers, made up of three single-phase units, it is generally customary to provide a fourth single-phase unit to serve as a spare and take the place of any one of the other three in case of accident. In order to be able to throw in the spare unit quickly, a system of double-throw disconnecting switches is often used, one side of each switch (*A* in Fig. 1) being connected to any one of three transformers, and the other sides of all switches (*B* in Fig. 1) being connected to a bus which is permanently tied into the spare transformers. Instead of using single-pole-hook disconnecting switches, double-pole, double-throw mechanically operated disconnecting switches are now generally preferred, in order to expedite the operation. The diagram of Fig. 1 shows a system of connections where I, II, and III are the three single-phase transformers making up the bank and IV is the spare unit. If, for instance, unit II is out of commission, it is only necessary to throw switch *J* over to its upper position *B* and to throw switch *M* over to its lower position *B* in order to throw unit IV on the phase occupied by unit II. This can be done without any "phasing-out" tests. Of course, the switching must be accomplished with the load off, or, in other words, with the oil circuit breaker open.

With the use of mechanically operated disconnecting switches it is possible to install auxiliary switches (*C* and *D*) on the mechanisms for operating red or green indicating lamps at various points. The auxiliary switches shown in Fig. 1 are so interlocked that the red lamps at each transformer will light when either side of the transformer is energized through the operation of any of the disconnecting switches, whereas the green lamp will light only when the respective transformer is absolutely de-energized and both sides of it are disconnected. This, as may readily be seen in Fig. 1, is not only the case on the transformers I, II and III, making up the bank, but also on the spare transformer IV, even though no switches are provided for this spare transformer. In addition, Fig. 1 shows a set of four lamps on the switchboard to indicate which of the four transformers is operating at any time.

In spite of all these precautions, this system is not to be recommended, for the reason that mistakes and accidents may occur where it is used. If, for instance,

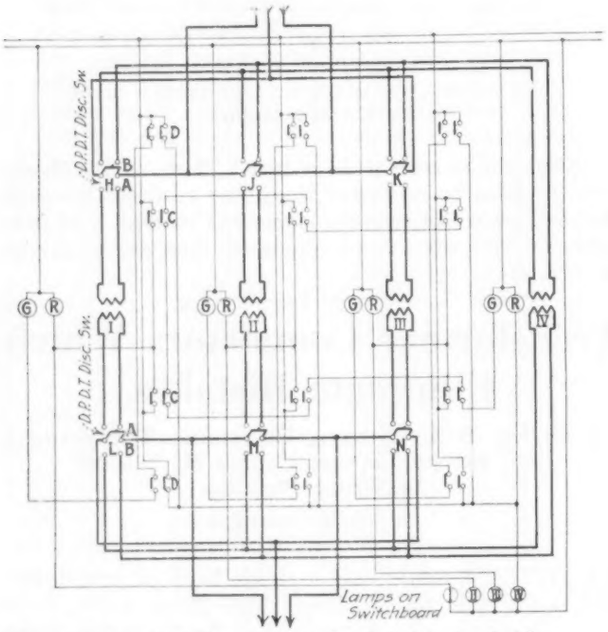

D.P.D.T. Disc. Sw.
D.P.D.T. Disc. Sw.
Lamps on Switchboard
C-D.P. Aux. Switch closed when disconnecting Switch is closed at A
D- " " " " " " " " " " B
Red Lamp at Transformer Lights when Transformer is alive on Either Side
Green " " " " only when Transformer is dead on Both Sides

FIG. 1—CONNECTIONS OF INDICATING LAMPS FOR SPARE TRANSFORMER

after unit IV has been thrown in to replace unit II, an accident should happen to unit I, the operator, being trained in the idea that he can replace a defective transformer by a spare one by simply throwing the switches of the defective transformer to their opposite positions, might throw switch *H* to its upper position (*B*), which would mean a short circuit, since switch *J* would also be closed in its upper position (*B*).

The transformers are not always within sight from the switches, nor are the low-tension switches always within sight from the high-tension switches. Thus an additional mistake can easily be made by throwing the low-tension switch of one phase and the high-tension switch of another phase, as for instance, switches *J* and *L*, in which case a mixing of phases would be the result.

In addition to these objectionable features of the system shown in Fig. 1, it is expensive and requires complicated wiring, as double-throw high-tension switches usually do. It is therefore preferable to use the much simpler, less costly and not at all dangerous scheme shown in Figs. 2 and 3. With this system a set of solid "jitney" buses are used for each of the high-tension and low-tension delta or Y connections.

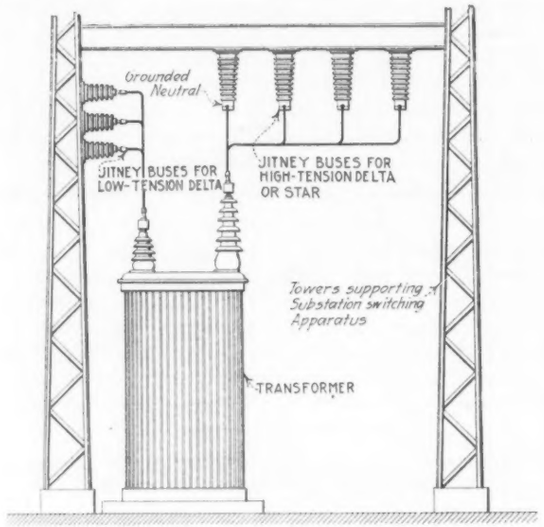

Grounded Neutral
JITNEY BUSES FOR LOW-TENSION DELTA
JITNEY BUSES FOR HIGH-TENSION DELTA OR STAR
Towers supporting Substation switching Apparatus
TRANSFORMER

FIG. 2—"JITNEY" BUS METHOD OF CONNECTING SPARE TRANSFORMERS

These buses extend over the full length of the space occupied by the four units. The connections from the three units making up the bank to the jitney buses are solid copper bar for the low-tension and copper pipe for the high-tension. Each of these connection bars or pipes will fit only between a transformer terminal and one particular phase of the jitney bus, and it could not possibly be used on another phase since it would be either too long or too short. In order to replace transformer unit II in Fig. 2 by spare

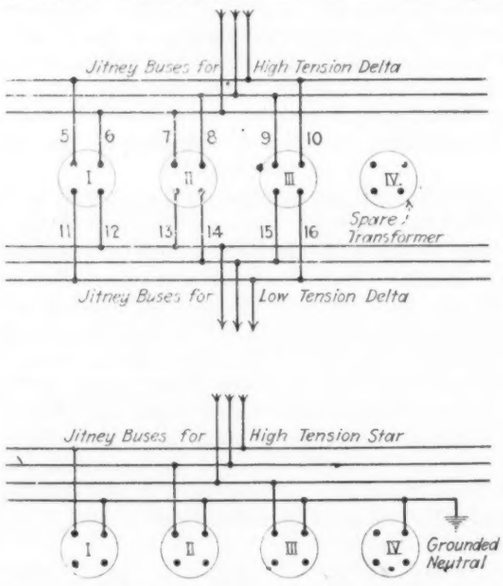

Jitney Buses for High Tension Delta
5 6 7 8 9 10
I II III IV
Spare Transformer
11 12 13 14 15 16
Jitney Buses for Low Tension Delta
Jitney Buses for High Tension Star
I II III IV
Grounded Neutral

FIG. 3—SUPPORTS FOR "JITNEY" BUS CONNECTIONS

unit IV bars 13 and 14 and pipes 7 and 8 are removed from No. II, and these bars and pipes are used for connecting the spare transformer to the jitney bus. It will not be necessary to phase out, since each of

the connections transferred from II to IV will fit only its proper phase and cannot be connected to any other phase. Offsetting the buses will prevent reversed connections. The operation of transferring the four connections from one transformer to another does not take more than a very few minutes, since it requires no testing and no fitting whatever.

Cost of Fuses for Service Entrances

Formulas for Finding Annual Costs of Standard and Renewable Type Fuses Used at Customers' Entrances on Central-Station Service Lines

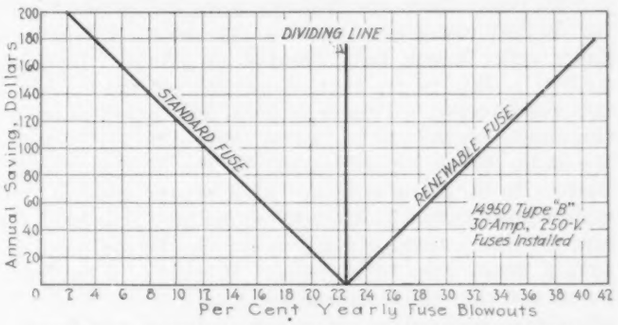
BY WILLIAM BAUM

A REPORT by a research engineer of a large Middle West public utility covering an investigation of fuse costs says: "The field for renewable fuses is in the protection of induction motors and other installations where frequent overloads occur. Unless an average of more than one fuse in four is blown every year, no saving will be effected over the cost of standard fuses by the installation of the renewable type." With renewals of less than 25 per cent per annum, it was found that the fixed charges on the investment in renewable fuses for use at customers' service entrances were much more than the saving due to the refillable feature.

This investigation covered fuses from 30 amp. to 200 amp. inclusive, and the great majority were for 250-volt service. The report was compiled during the latter part of 1918, and the following cost figures were used as a basis for comparison:

Before any conclusions could be arrived at it was necessary to determine the number of fuse renewals required on the company's system. A careful study of the records and an analysis of conditions showed that out of 34,407 fuses in service 2,989 were blown during one year. The blowouts, therefore, amounted to 8.7 per cent.

These fuses were installed at the customers' service entrance. This figure was compared with that arrived at by engineers not connected with the company who had had experience in this line. Under similar



EFFECT OF BLOWOUTS ON CHOICE OF MOST ECONOMICAL TYPE OF FUSE

conditions they had found the annual blowouts to range from 7 per cent to 10 per cent. This does not hold true in induction-motor installations, where the extreme variations of load cause a much higher percentage of blowouts a year.

The summary of the results shown in the table indicates that, under the prevailing conditions on that company's system, the standard fuses were more than $600 a year cheaper than renewable fuses. Results also showed that the percentage of blowouts would have to be increased from the present figure of 8.7 per cent to an average of about 25 per cent or more before conditions would change in favor of the renewable type of fuse.

COST COMPARISONS OF STANDARD AND RENEWABLE FUSES USED AT SERVICE ENTRANCES WHERE BLOWOUTS WERE 8.7 PER CENT PER ANNUM

Standard Fuse Data				Annual Cost of Standard Fuses			Comparative Annual Cost Renewable Fuses				
Amp.	Volts	Number in Use	Number Blown in One Year	12 per Cent Fixed Charges	Renewals	Total	12 per Cent Fixed Charges	Renewals	Total	Annual Saving with Standard Fuses	Blowouts per Annum to Give Equal Cost, per Cent
30	250	14,950	1,300	$179.40	$130.00	$309.40	$398.40	$45.50	$443.90	$134.50	22.5
35-60	250	14,050	1,221	219.60	158.73	378.33	525.00	64.71	589.71	211.38	28.2
30	600	96	6	1.72	.90	2.62	4.02	.31	4.33	1.71	24.7
35-60	600	391	34	10.79	7.82	18.61	24.82	2.41	27.23	8.62	22.5
65-100	250	2,700	235	110.16	79.90	190.06	259.84	31.25	291.09	101.03	26.7
110-200	250	2,220	193	202.46	146.68	349.14	474.18	40.53	514.71	165.57	22.2
		34,407	2,989	$724.13	$524.03	$1,248.16	$1,686.26	$184.71	$1,870.97	$622.81	24.3

A figure of 12 per cent was taken for fixed charges, which included 6 per cent interest, 5 per cent depreciation and 1 per cent taxes. The number of fuse blowouts necessary to produce an equal renewal expense with either type was then obtained by subtracting the fixed charges for standard fuses from the fixed charges for renewable fuses and dividing the result by the difference between the two unit renewal costs. The formula is as follows:

$x = (b - a) / (c - d)$

x = number of fuse blowouts to give equal renewal costs.

a = fixed charges on capital invested in standard fuses.

b = fixed charges on capital invested in renewable fuses.

c = unit renewal cost (also first cost) of standard fuse.

d = unit renewal cost of renewable fuse.

The relationship between annual saving with either type of fuse and the percentage of fuse blowouts per year can be plotted on a curve for any size of fuse and set of conditions. A sample curve of this description is shown in the illustration. The curve is based on the prices and fixed charges given in this article and on an installation using 14,950 type B 30-amp., 250-volt standard fuses.

While this is a characteristic curve, it may not apply under other conditions. A special curve should be worked out for each individual case, taking into consideration any unusual factors.

Readers' Views and Comments

The 50-Deg. Motor a Remedy for Overmotoring

To the Editor of the ELECTRICAL WORLD:

SIR: While there are probably some industries where the 50-deg. motor may prove a detriment, in pulp and paper mills it will be a decided advantage. In these mills it is safe to say that 95 per cent of the machines are overmotored. This may seem like a reflection on the ability of the electrician in charge, but it is really the fault of the superintendent or the designing engineer. He is more familiar with steam engines and waterwheels than with electric motors, and it is hard for him to believe that so much power can be delivered by such a small mass of material. When he is buying a pump and the manufacturer specifies a 40-hp. motor he plays safe and orders one rated at 50 hp. If he gets a 40-deg. rise motor he has one capable of carrying 60 hp. continuously, and in place of being 10 hp. overmotored he has 20 hp. more capacity than is actually needed.

Thus he has an increased first cost and a lower efficiency and power factor than if he had bought a 50-deg.-rise motor. While the 50-deg.-rise motor will not entirely cure the overmotoring, it will be a decided check to the disease. RALPH MCKINNEY.

Brown Company, Berlin, N. H.

Fallacies in Fixture Ventilation

To the Editor of the ELECTRICAL WORLD:

SIR: When the gas-filled tungsten lamp first came on the market designers of fixtures and sockets to take these lamps were suddenly confronted with the necessity of providing for greater heat around the lamp base than had before been common. Consequently much attention began to be given by designers to ventilation, as the chief means of getting rid of the undesirable heat. It now begins to appear that many of the attempts at ventilation might better have been omitted, and that it would be better to conduct the heat away from the lamp socket to a point where effective cooling could be obtained by radiation and by convection into surrounding circulating air currents than to circulate air through a lamp globe.

Ward Harrison of Cleveland, before the Illuminating Engineering Society, Chicago Section, in February gave some interesting figures of tests which showed that a common type of ventilation in which air is taken in through a hole in the bottom of an inclosing globe and allowed to circulate up around the socket gave very little lower lamp base temperature than if a closed globe were used, while the practice had the very serious disadvantage of drawing so much outside air through the globe that much dirt was deposited on lamp and globe.

A careful study of thermal conductivities, including both the transfer of heat from metal and glass to air and the reverse process, should usually make it possible to design inclosed fixtures for large lamps which will stay cleaner much longer than the inclosed ventilated type. The requirements are, primarily, plenty of external radiating surface and ample paths of high thermal conductivity from the lamp base to these external radiating surfaces.

One reason for the result quoted by Mr. Harrison is that the circulation of air inside an inclosed globe fixture serves as a fairly good medium of heat exchange between the lamp base and neck and the outside of the fixture. To be sure, the thermal conductivity of air is not particularly good—in fact, air is one of the best known insulators when it is not permitted to circulate—but experience with heat-insulating materials shows that circulation of air is very effective in bringing about heat exchange and that the air must be very closely confined if its heat-insulating qualities are to be made use of. The lesson to be learned from this is that air circulation within a fixture of the inclosed globe type may be made quite effective in transferring heat. At any rate, the ventilation of the inclosing globe for gas-filled lamps has undoubtedly been overdone in some cases, and the design of the future should be along more scientific lines. J. R. CRAVATH,

Chicago, Ill. Fowle & Cravath.

Formulas for Calculating Antenna Constants

To the Editor of the ELECTRICAL WORLD:

SIR: You may be interested in some work I have been doing in the field of radio-engineering, *i.e.*, in the derivation of new formulas for the accurate calculation of the true and equivalent antenna constants of long and horizontal aërials. I have checked the formulas by many experiments and found that they hold with a very good degree of approximation also for many power aërials used.

The formulas for the correct antenna constants are:

$$C_{e_1}{}^F = A_1 C_A{}^F,$$
$$L_{e_1}{}^H = B_1 L_A{}^H,$$
$$r_e{}^\Omega = B_1 r_A{}^\Omega,$$

while for the apparent effective constants they are:

$$C_{e_2}{}^F = A_2 C_A{}^F,$$
$$L_{e_2}{}^H = B_2 L_A{}^H,$$
$$r_e{}^\Omega = B_1 r_A{}^\Omega,$$

if C_e, L_e and r_e refer to the value of the effective capacity, of self-induction, of resistance, and C_A, L_A and r_A to the corresponding true constants. The constants A_1, B_1, A_2 and B_2 are given by:

$$A_1 = \frac{8\lambda'}{\pi\lambda} \frac{\sin^2 \lambda/\lambda' 90^\circ}{\pi\lambda/\lambda' + \sin 180^\circ [1 - \lambda/\lambda']}$$

$$B_1 = \frac{\lambda'}{2\pi\lambda} \frac{\pi\lambda/\lambda' - \sin 180^\circ [1 - \lambda/\lambda']}{\sin^2 \lambda/\lambda' 90^\circ}$$

$$A_2 = \frac{2\lambda'}{\pi\lambda} \sin \lambda/\lambda' 90^\circ$$

$$B_2 = \frac{2\lambda'}{\pi\lambda} \frac{1 - \cos \lambda/\lambda' 90^\circ}{\sin \lambda/\lambda' 90^\circ}$$

$\lambda''' =$ wave length for unloaded antenna; $\lambda'''' =$ wave length for coil-loaded antenna.

The true antenna constants for a loading self-induction L_o are therefore found from the expressions

$$L_A{}^H = \frac{A_1 - A_2}{A_2 B_2 - A_1 B_1} L_O{}^H$$

$$C_A{}^F = \frac{\lambda^2}{144 \times 10^{16} L_A{}^H}$$

Berkeley, Cal. AUGUST HUND.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Transformers Quickly Cleaned by Gasoline Circulated Through Oil Filter

CLEANING transformers with gasoline circulated through an oil filter press has been found by the Northwestern Power & Manufacturing Company to save time and labor. After all oil has been pumped from the transformer sufficient gasoline is poured into it to cover the end of the hose or pipe leading to the suction side of the filter. To the discharge end of the filter a hose is attached with a nozzle through which the gasoline is sprayed on the transformer. The washing is started at the top of the transformer and carried down. With large transformers the core is raised as the washing proceeds to make the cleansing easier and more thorough. If the transformer is very dirty, it may be necessary to change the filter papers, of which two are used, or to scrape the caked dirt off them. After the transformer is cleaned the gasoline is stored for further use and the transformer is dried by the short-circuit method for twenty-four hours and then filled with oil. Before the transformer is put back into service the oil is tested.

Besides using this method to wash transformers it has been also used to clean high-tension switches without disassembling them, thus saving much time and labor.

A. L. LOFTSTRAND.

Port Angeles, Wash.

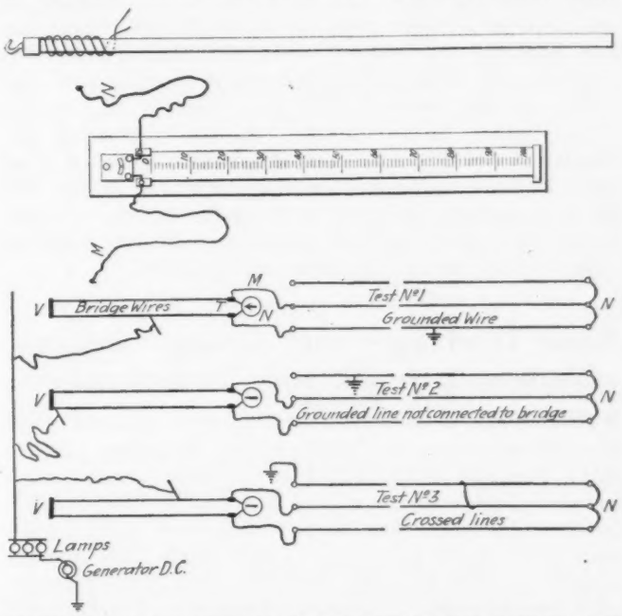
Transmission Line Troubles Quickly Located

Application of Murray Loop Test with Slide-Wire Bridge Permits Position of Ground or Short-Circuit to Be Accurately Determined from Station

A SATISFACTORY device for locating distant transmission-line troubles was rigged up by the Cleveland Cliffs Iron Company at a total cost of $250. The equipment consists of a small motor-generator set, a galvanometer, a slide-wire bridge and an insulated platform. By means of this equipment and the Murray-loop test faults have been located on the company's 85 miles (175 km.) of transmission line to within one or two spans of the exact spot. The apparatus is inexpensive, accurate and the maintenance expense during the five years in which it has been in service has not exceeded $10.

A schematic diagram of the arrangement is shown herewith. When one line is grounded it is connected to one of the other wires at the distant end of the line. A spring connector on the end of a pole as shown is used for this purpose. The bridge arms are then connected to the other ends of the same lines as shown. Direct-current energy is required for testing and is supplied in this case from a 0.2-kw. motor-generator set, upon which the direct-current potential may be varied from 0 volt to 500 volts. When no other direct-current service is available an accurate test can usually be obtained with a battery of from ten to twenty primary or secondary cells, and almost any wire can be used for a bridge in an emergency.

One side of the direct-current of the motor-generator set should be grounded, and in this particular case three 50-watt, 240-volt lamps are connected in the circuit in multiple series. The other side of the direct-current system is connected to the sliding contact on the bridge. The slide is then moved along one or both sides of the bridge until a balance is established as shown by the galvanometer being at zero. The fault will then be on the phase connected to the bridge wire upon which the balance was obtained and will be proportionately in the same position on the outside lines from *T* to *Z* that the sliding contact is on the bridge wire between *T* and *V*. A table which was worked out for each circuit gives the location of each tower and its percentage corresponding to the percentage on the bridge.



CONNECTIONS FOR FINDING TRANSMISSION-LINE FAULTS, AND SLIDE-WIRE BRIDGE AND CONNECTING POLE

The bridge wires are divided into 100 divisions of 1 mm. each. The pole is used to connect a bridge wire with a defective line. The bottom hook of the spring is placed under a bridge-connecting wire and the pole is pushed up until the top hook connects with the desired line wire. The pole is light and hangs in position until the line is disconnected. The bridge-connecting wires run under all outgoing lines to facilitate connection. One pole is required for each line to be connected. The two bridge wires each consist of 100 mm. of No. 16 tinned steel wire. The leads *M* and *N* are of about the same conductivity as that of the line to be tested, and they should both be of equal lengths. A telephone receiver or low-reading voltmeter may be used when no galvanometer is available. When a balanced condition has been obtained there will be no reading on the voltmeter and no sound in the telephone receiver.

As a matter of convenience, all phases are often short-circuited instead of simply connecting the defective line

with one of the others. When this is done two clear lines are sometimes connected to the bridge by mistake. Under such conditions the sliding contact on the bridge will be at *V* when the galvanometer is at zero (see test No. 2). This indicates either that the faulty line has not been connected to the bridge or that the fault is near the point where the phases have been short-circuited. If two wires have become crossed or short-circuited, as shown in test No. 3, one of the short-circuited lines should be grounded at any convenient point before the test is made. This will be equivalent to a ground at the short circuit, which may then be located by the same procedure as in test No. 1.

F. C. STANFORD,
Cleveland Cliffs Iron Company. Electrical Engineer.
Ishpeming, Mich.

Megger Successful for Testing Insulation and Locating Cable Grounds

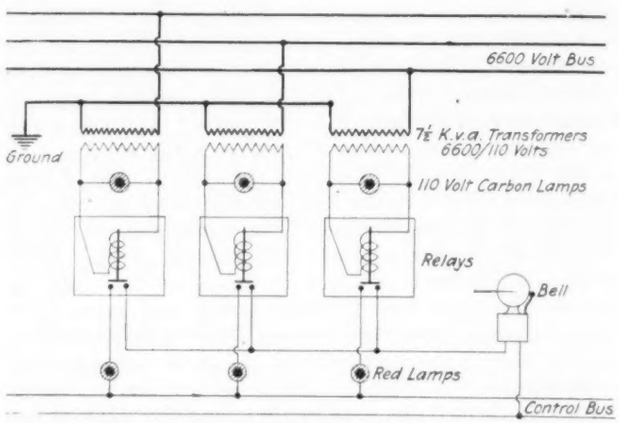
FOR determining insulation resistance megger tests are sufficient, but for tests of dielectric strength these must usually be supplemented by high-voltage or high-frequency tests. The main uses of the megger, as indicated in a recent meeting of the Empire State Gas and Electric Association, were as follows: (1) For routine tests of insulation resistance of equipment and cables, so that deterioration of insulation may be revealed before failure occurs; (2) for measuring the insulation resistance of apparatus which is being dried out; (3) for hunting trouble in underground cables. For the last purpose, however, it is the consensus of opinion that overvoltage tests should be put on doubtful cables before service is resumed over them.

Static Discharger and Ground Detector Made with Small Stock Transformers

PERSISTENT insulator trouble was stopped on a 6,600-volt line in Michigan by draining off the static through three small stock transformers each connected to a phase of the line and to the ground. Later these transformers in connection with lamps and relays were used as a very satisfactory ground detector. The 7.5-kva., 6,600/110-volt transformers used for the purpose were connected with their "high" sides in star, the neutral of which was grounded and the three points attached to the three phases of the station bus, while the 110-volt sides were left open. The trouble, which had been present for two years, causing interruptions and loss of insulators, was eliminated when the discharger was installed.

During further experimenting with this apparatus it was discovered that with certain modifications it would serve as a dependable ground detector. The first of these modifications was to connect a 110-volt carbon lamp across the secondary leads of each transformer. Under normal conditions these lamps show red as about 58 per cent of normal voltage is impressed on them, but when a leg of the line becomes grounded the corresponding lamp filament becomes black, since the primary voltage on the transformer drops. At the same time the other lamps will receive full voltage as the primaries of the transformers are subjected to 6,600 volts. In this way the grounded leg is always indicated by the dark lamp.

As an additional refinement, Westinghouse type C. V. relays were connected to the small transformer secondaries in order to close a control circuit when the secondary voltage falls to 50 volts. The closing of the control circuit rings an alarm bell and lights a red lamp. The lighted red lamp indicates the line which is in trouble, and the transformer lamps indicate the extent of the trouble. If the carbon lamp on the transformer is dark, the operator knows a dead ground has occurred, whereas if the lamp glows, but not so brightly as the other two, he knows that there is an arcing ground on the line. More accurate in-



HOME-MADE STATIC DISCHARGER AND GROUND DETECTOR

formation could be obtained if desired by the use of voltmeters instead of or in conjunction with the carbon lamps.

This ground detector proved so successful on the 6,600-volt system that it has been installed on the company's 13,200-volt line, where it has proved equally reliable. The transformers which were available for the 13,200-volt line were of 5-kva. capacity, and these were used. The load on the transformer consists of the signal apparatus, and only a small-sized unit is required. Both the 6,600-volt and the 13,200-volt lines are carried upon steel structures or upon wood poles with steel cross-arms grounded at each pole. The plan outlined would not work so accurately on lines not metallically grounded.

CHARLES E. HARGER,
Peninsula Power Company. General Superintendent.
Iron River, Mich.

Transformer Practice on Rural Transmission Lines

TWENTY-FIVE-CYCLE transformers are used on both the 25-cycle and 60-cycle, 13,200-volt rural lines radiating from one of the cities on the Great Lakes and there have been no complaints about the service. The regulation is known to be poorer on the 60-cycle than on the 25-cycle service, but as the customers were satisfied the transformers were not tested to find out the exact results.

The company has 13,200-volt and 26-400-volt, 60-cycle lines for which 60-cycle transformers as small as 10 kva. are purchased with windings for both voltages. Smaller transfomers were required for some customers, but 5-kva. or 7.5-kva. units wound for 13,200 volts to 26,000 volts (primary) cost but little less than the 10-

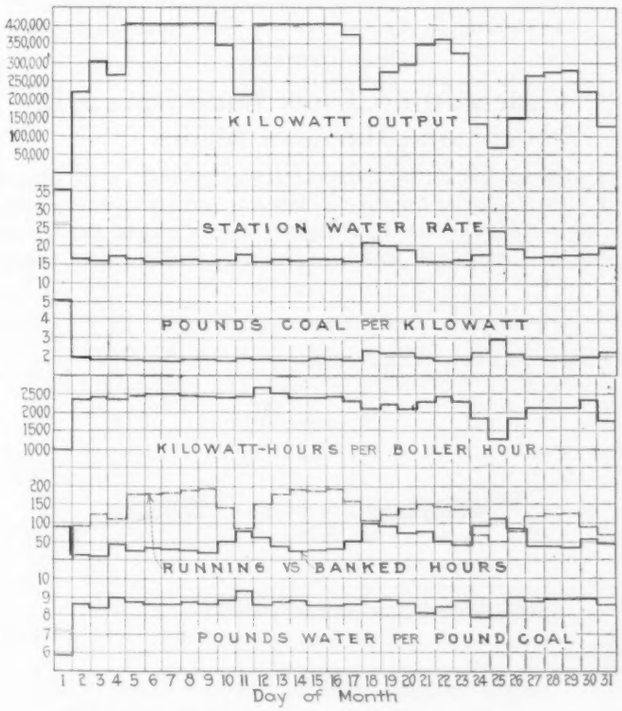
kva. size. This is why the 5-kva., 13,200-volt transformers purchased for the 25-cycle lines were used on the 60-cycle lines.

This particular company uses only 5-kva., 10-kva. and 15-kva. units in supplying service to its rural customers. A 5-kva. transformer is used for a connected load up to about 9 kva., about three times as much is connected to a 10-kva. unit, and from 35 kva. to 45 kva. is connected to transformers rated at 15 kva.

Milwaukee, Wis. ROY L. DODD.

Graphic Operating Record Shows Daily Plant Performance

THE major operating records of the United Electric Light Company, Springfield, Mass., are plotted day by day on large sheets to show at a glance the more important items bearing upon plant efficiency. The two sheets (combined in the reproduction shown here) give the daily kilowatt-hour output, the water rate, the fuel consumption per kilowatt-hour, the energy output per boiler-hour, the amount of banking and operating



DAILY OPERATION OF PLANT EASILY SEEN

hours, and the evaporation. A summary of the month's performance is tabulated at the right of one chart. These charts, which are 10.5 in. x 19.5 in. (38 cm. x 50 cm.), offer a quick means for visualizing plant conditions. It will be seen from the accompanying curves that the plant efficiency improved, as a rule, as the relative amount of boiler banking was reduced, and also as the total output increased. The lighter Sunday loads and a period when one of the larger turbo-units in the plant was shut down for repairs imposed a decided handicap on efficiency. The monthly over-all figure, however, of 1.97 lb. (0.9 kg.) of coal per kilowatt-hour show excellent economy. The charts were designed and prepared by McClintock & Craig, Springfield, consulting and supervising engineers, for the United Electric Light Company.

Underground Records of Central Station Prove Valuable

THE maintaining of complete maps and card records of its distribution system by the United Electric Light Company of Springfield, Mass., has proved of great value in connection with reconstruction work, additions to transformer, manhole and line equipment.

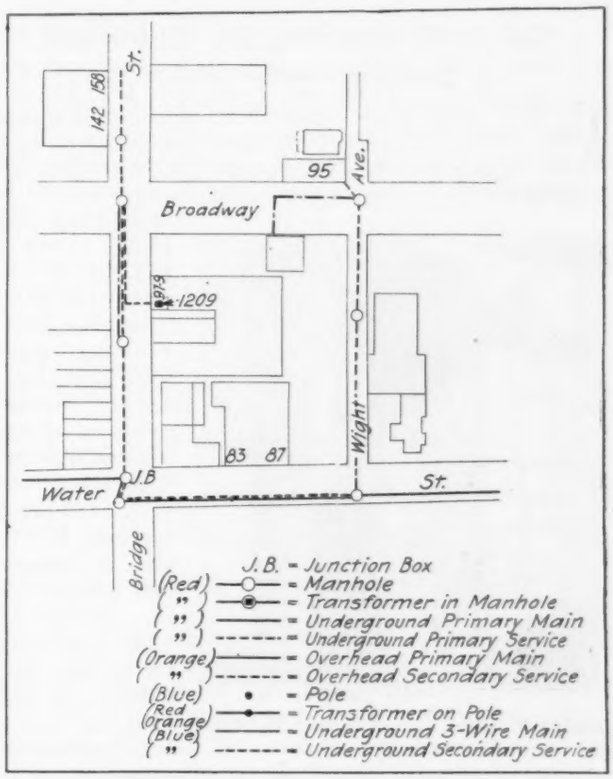


FIG. 1—SECTION OF MAP SHOWING UNDERGROUND DISTRIBUTION SYSTEM

Moreover, in case of operating trouble the records facilitate the restoration of service. A typical section of an underground system map is reproduced in Fig. 1. The key provides for showing manhole locations, transformer installations, overhead and underground primary mains and secondary services, pole locations and abutting real estate. Red, yellow and blue lines are used in the drawing for identifying the various equipment,

Circuit No. 19 / 1209	Trans. Make W.H.	No. 30626	Size 4.00 K.W.
	Date Installed April 29, 1913	Connected Load 3.2 K.W.	
Area	Lamps 16 C.P. Equiv. / Motors	Customer	Street / No.
	64	Broadway Theatre	Bridge St. 99

FIG. 2—EACH TRANSFORMER HAS A CARD

and a card record (Fig. 2) is kept for each transformer, giving the connected load thereon, size, make, date of installation and other information convenient in case field men telephone in to the headquarters of the department.

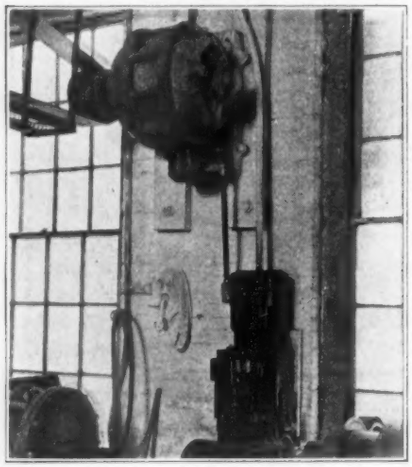
The manhole card record system employed by this company was described in the Aug. 16, 1919, issue of the ELECTRICAL WORLD on page 360. W. H. Bolewine is superintendent of distribution for the United Electric Light Company.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Side Wall Mounting for Motor and Starting Compensator

IN THE ELECTRICAL WORLD for Feb. 28, 1920, page 499, a method was shown for mounting motors on combined wood and iron beams. In this connection the method shown in the accompanying illustration will be of interest. The 15-hp. motor is supported by bolts passing through a 16-in. (42-cm.) brick wall. This allows a very compact grouping of motor and starting apparatus. The ⅝-in. (16-mm.) through bolts used to support two 2.5-in. x 7-in. (6.4-cm. x 18-cm.) plank strips are provided with 6-in. (15-cm.) cast-iron washers to distribute the strain on the bricks, which is considerable on account of the pull of the belt. The motor is bolted to these plank strips. Directly under the motor the control apparatus is mounted. It consists of a starting compensator and overload-relay trip coils, requiring a conduit run of only 20 in. (51 cm.).



COMPACT MOTOR AND STARTER MOUNTING ON BRICK WALL

WALTER B. ATCHISON,
Electrical Engineer.
Chapman Valve Manufacturing Company,
Indian Orchard, Mass.

Electric Ovens Save Dies in Steam Wire Mills

COMPARED with ovens heated by coal, coke or steam for making steel wire, the electric oven saves dies, takes a smaller number of annealing and pickling processes in drawing down the bars, and consequently turns out a larger output in a given period. Owing to the dusty condition of combustion in coal-fired or coke-fired ovens, considerable dust is deposited upon the outside surface of the wire when such fuel is used for heating. This dirt and grit has a very destructive effect upon the dies through which the wire is drawn.

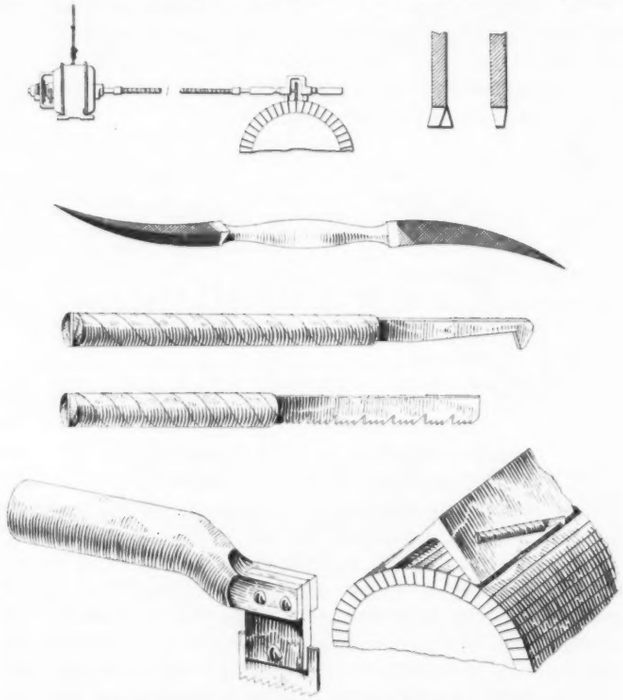
It is an easy matter to maintain any desired temperature in the electrically heated oven, and as it contains no combustible material, very little scale is formed on the wire by this method of annealing. On the other hand, it is seldom possible to maintain a temperature in excess of 600 deg. F. (315 deg. C.) in ordinary coal-fired or coke-fired ovens, and in steam-heated ovens expensive superheaters must be installed to maintain even this temperature.

Furthermore, in pickling, certain classes of wire very frequently receive a light pickle immediately after being drawn to remove grease and dirt. If this wire is then placed in an electric oven, the pickling acid can be dried off and the wire annealed in one operation. The time and trouble of the pickling process are thereby reduced, and the wire can be returned directly from the electric oven to the next drawing operation.

Halcomb Steel Company, Syracuse, N. Y.
EDWARD T. MOORE,
Electrical Engineer.

Undercutting Tools Made from File and Hacksaw Blades

FOR undercutting commutator mica industrial plants with a large number of motors can make some very handy tools for use on armatures taken out of the frame and on armatures which are to be worked on in place.



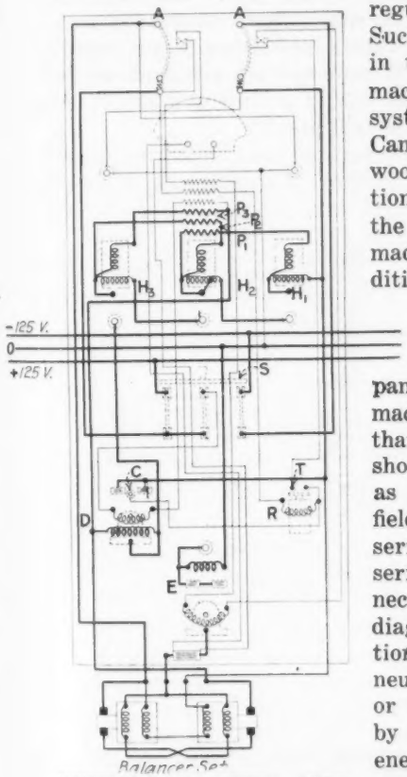
UNDERCUTTING TOOLS MADE IN THE SHOP

For small armatures which can be taken from the frame a circular saw about 1 in. (2.5 cm.) in diameter driven through a flexible shaft facilitates work. The "set" of the saw should be ground off and a guard provided to limit depth of cut to about ½ in.

For working on an armature in its frame a hand tool is better. A thin three-cornered file may be used to start a groove in the mica, after which the file or a hack-saw tool shown in the drawing may be used to deepen it. A silversmith's "riffler," which is a curved double-ended file, may be employed. Some experienced men consider that a straight edge and a hook are the most efficient tools. The edge of a piece of angle-iron longer than the commutator will be parallel to the slot and is a very handy straight edge. For a hook a hacksaw may be ground into any of several different shapes and a handle formed of tape or wood taped on the blade. About four good strokes with a sharp hook will remove 1/32 in. (0.9 mm.) of ordinary mica, which is the proper depth.

Automatically Closing Neutral on Balancer Set

BY CAREFULLY selecting machines that are as nearly alike as possible a direct-current balancer set may be arranged to have its neutral thrown on the system automatically without an operator first checking and regulating the voltage. Such a condition is found in two 12.5-kw., 125-volt machines connected to the system of the American Can Company at Maywood, Ill. The connections are arranged so that the neutral connection is made by means of an additional relay and magnetic contactor mounted on an ordinary motor-starting panel. In selecting the machines care was taken that the saturation curves should be as nearly alike as possible. The shunt fields are connected in series on 250 volts and the series fields are cross-connected. The accompanying diagram shows the connections on the board. The neutral magnetic contactor is at *E*. It is closed by the relay *R*, which is energized through the auxiliary contact *C* on the main line switch *D*. The sequence of operation is as follows: The circuit breakers *AA* are closed. Then the switch *S* is shoved in. The current passes directly to the positive side of the balancer set, and the negative side is connected through the resistance P_1, P_2, P_3 and the coils H_1, H_2, H_3, which automatically cut out in succession as the motors come to speed. When full speed is reached the circuit breaker *D* closes the line directly on the set. Then the auxiliary contact *C* is connected to the negative side of the line. Current passing through the relay *R* closes the contact *T*, which energizes the magnetic contactor *E*. This connects the neutral of the set on the line. Should the line circuit breaker *D* open, the coil *M* will release and the contactor *E* will open.



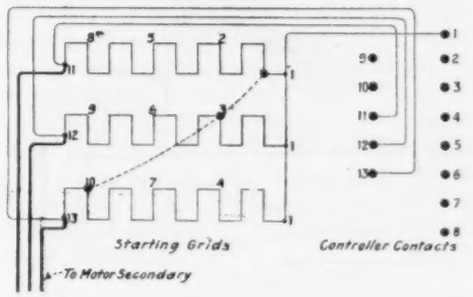
NEUTRAL CONNECTED AUTOMATICALLY BY CONTACTOR AT *E*

E—Magnetic contactor for closing neutral. *R*—Relay energizing neutral contactor. *D*—Circuit breaker in negative line to balancer set. *C*—Auxiliary contact to energize relay *R*. H_1, H_2, H_3—Starting coils. P_1, P_2, P_3—Starting resistances. *A*—Main circuit breakers.

J. A. TOLEIK,
Electrical Engineer.
American Can Company,
Chicago, Ill.

Motor-Starting Trouble Illustrates Necessity for Checking Connections

THE importance of checking connections after installing electrical equipment was demonstrated in the improper starting of a 550-volt, 200-hp. slip-ring motor recently installed in a western Massachusetts stone quarry. When the controller handle of this motor was thrown to the starting position the motor quickly jumped to full speed before the handle was thrown to the running position. An investigation of the controller connections explained this by showing that part of the starting grids were shunted out during starting, as indicated by the dotted lines in the diagram. After the connectors for the common lead were changed to studs 1-1-1 the motor started in the proper manner, by not coming up to speed until the handle was thrown to the second position.



WRONG CONNECTION THAT STARTED MOTOR TOO FAST

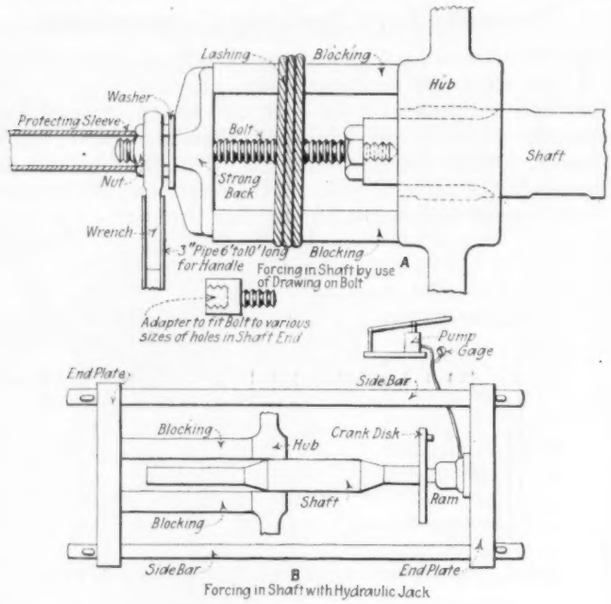
ARTHUR R. MCDONALD.
McCleary, Wallin & Crouse,
Amsterdam, N. Y.

Screw Device for Forcing Armature on Shaft

FOR forcing an armature on a shaft the screw device shown in the accompanying illustration has been successfully used in an Eastern repair shop. This device consists essentially of a 3-in. (75-cm.) screw or bolt, one end of which is fastened into the shaft, the other end having a nut, which is screwed against a push plate and blocking that in turn bears on the armature, pushing it on the shaft. In using the device the bolt is first screwed into the threaded hole in the end of the shaft. If it does not fit, it is necessary to use an adapter having a screw on one end which fits the shaft and a threaded socket on the other end which fits the bolt. When this bolt is mounted in the shaft an iron push plate, or "strong back," is fitted over the bolt and the nut is screwed up against this plate with a heavy washer between them. Then hard-wood blocking is placed between this plate and the hub and the bolt is tightened. It is well to lash the blocking in place with rope to prevent buckling. By means of a wrench and a piece of pipe used as an extension handle the nut can be screwed up on the bolt, forcing the hub onto the shaft. A 3-in.

(75-cm.) bolt will easily give 90 tons pressure with a 10-ft. (3-m.) handle. For medium-sized shafts the pressure required is 40 tons to 50 tons. Larger shafts take as high as 125 tons, and for shafts with a bore larger than 14 in. (35 cm.) the use of a hydraulic press is recommended.

Before forcing a hub on a shaft the diameter of each is measured. The shaft is always slightly larger than the hole in the hub, usually 0.00025 in. for each inch of



METHODS FOR FORCING AN ARMATURE ON A SHAFT
ABOVE, WITH SCREW; BELOW, WITH RAM

shaft plus 0.001 in. (0.0025 mm. for each cm. + 0.25 mm.). If the difference is greater, the bore must be increased by scraping or the shaft must be reduced to prevent jamming. Micrometers are used to measure this allowance, or a pin gage may be made for the hub and the shaft measured with stiff calipers and the difference measured with a feeler gage. If the difference is correct, before the forcing is started the tapped hole in the shaft, the bolt and the shaft and bore must be cleaned and oiled. A thin mixture of oil and white lead is applied to the shaft and the washer should be lubricated with a graphite grease before starting. In order to prevent injury to the bolt when shifting the wrench, a protecting pipe sleeve is placed on the bolt behind the nut.

For shafts over 14 in. (36 cm.) in diameter a hydraulic pump and ram, arranged as shown, may be employed. The end plates of the frame are I-beams bolted together or heavy wooden beams, and the side bars are steel bars, rails, cables or chains.

Cleveland, Ohio. JAMES DIXON.

Desirable Properties in Insulation

In selecting insulation for electrical rotating machinery the following properties must be investigated: (1) High insulating quality; (2) ability to withstand mechanical strain; (3) ability to withstand vibration; (4) flexibility; (5) longevity; (6) ability to exclude moisture; (7) ability to withstand heat; (8) ability to withstand acids; (9) adaptability to use in small space, and (10) good heat conductivity.

Iron Plates Used to Provide Support for Conduit on Brick Walls

IRON plates for holding conduit to walls other than wood have been found more satisfactory by the writer than the wood plugs that are commonly used. These plates are drilled and countersunk for a wood screw, which is held in the wall by expansion shields, and the conduit straps in turn are fastened by machine screws to the plates.

For a single ½-in. (1.2-cm.) conduit the plate is of black iron, ⅜ in. x 1 in. x 2½ in. (1 cm. x 2.5 cm. x 6 cm.), drilled and countersunk in the center for one No. 16 1¾-in. (4-cm.) flat-headed wood screw which fits into a ¼-in. x 2-in. (0.6-cm. x 5-cm) expansion shield set in a ¼-in. (0.6-cm.) hole in the wall. To hold the pipe straps the plate is drilled and tapped for ⅜-in. (5-mm.) machine screws. For carrying three runs of conduit, as shown in the illustration, a larger plate supported by two wood screws is drilled for four machine screws for the three pipe straps. For conduit over 2 in. (5 cm.) in diameter ⅝-in. (8-mm.) expansion shields are used with No. 18 wood screws and the plates are ½ in. thick by 1½ in. wide (1.2 cm. x 3 cm.). These plates are about 6 ft. (2 m.) apart along the run. These plates for single risers may be kept in stock and other plates may be made to suit the job. When a number are required they are cut by a power saw six at a time and drilled and tapped in a four-spindle drill press.

Their use insures strong and neat construction and reduces the number and size of holes to be drilled in

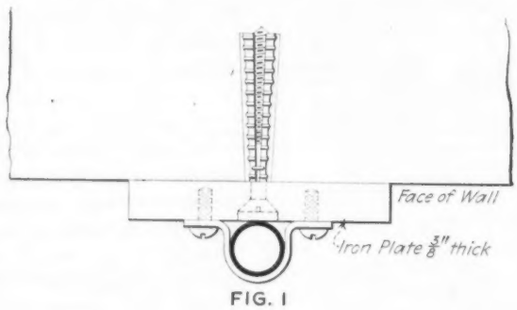


FIG. 1

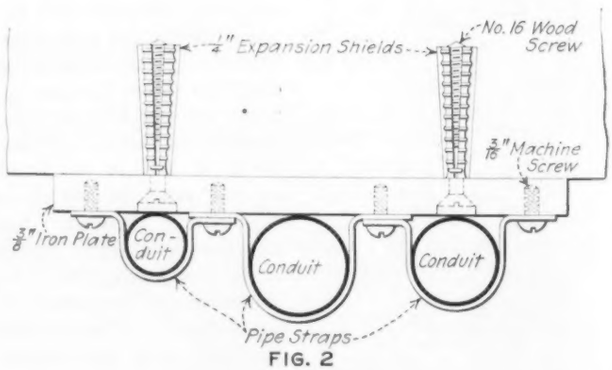


FIG. 2

METHOD OF USING IRON PLATES FOR FASTENING CONDUIT TO BRICK WALLS

the wall. Another advantage is that irregularities in the wall may be compensated for by placing shims or blocks under the plates. Moreover, unlike the wooden plug which usually shrinks and becomes loose in the hole, the expansion screws maintain their hold permanently. L. E. WOOD.

Glasgow, Scotland.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Merchandising Results in Scattered Texas Towns

ELECTRIC appliances sold during the year 1919 and during the month of January 1920, in twenty-one towns served by the Texas Power & Light Company, exclusive of the large cities, are listed in the accompanying table taken from a sales report in the *Texas Utility News*.

Since the average population of the towns is less than 12,000, it has been deemed unprofitable to maintain a separate sales force in each district. A commercial department, however, is maintained which devotes its efforts to each territory in turn, thus enabling each company to benefit from the work of the department at a very low individual selling expense. The gross revenue shown for the year 1919 of $220,857 is exclusive of lamp sales.

Appliance	No. Sold Year 1919	No. Sold January, 1920
Electric ranges	469	35
Vacuum cleaners	663	51
Washing machines	301	50
Irons	2,285	242
Heaters	519	73
Miscellaneous appliances	3,641	655
Total	7,878	1,106
Gross revenue from merchandise sales	$220,857	$19,837

Central-Station Assistance in Financing Range Sales

WITH the feeling that central stations should take the initiative in the pushing of range sales but that the co-operation of the retail dealer should nevertheless be obtained in furthering the interests of the range business with the public, several of the power companies of the San Francisco Bay region have adopted a policy of assisting in the financing of range sales as handled by retail dealers.

The Great Western Power Company has offered to handle any range sales made by contractor-dealers to consumers on its lines on a time-paying plan, agreeing to take over the obligation of making collections on the sale and to pay the dealer the full price of the range immediately. This arrangement provided that the dealer shall supply the range from his own stock and obtain a signed contract on the regular form supplied by the company. A cash payment of at least 10 per cent must be made by the customer at the time of sale, the remainder within nine months. Each contract must be approved by the district manager of the company in whose district the sale is made, who of course before approval investigates carefully the credit standing of the purchaser and secures also a written statement from the customer that the range has been satisfactorily installed by the dealer. When such a sale has been approved a requisition is forwarded to the purchasing department giving necessary information as to type of range sold, cost, consumer's name and address, dealer's name and address and so on. The purchasing department then places an order on the contractor-dealer in question, who renders his bill in triplicate just as though he had sold the range to the power company in the first place.

The Pacific Gas & Electric Company has made a similar arrangement with dealers in its territory by which the company allows the dealer 10 per cent on all range "prospects" turned over to it when the sale is actually consummated. The company also assumes the wiring charge in districts other than San Francisco and Oakland. If the name has been turned in by a contractor in the first place, the electric company agrees to give the wiring job to the contractor who submits the estimate 10 per cent lower than the bid of any other competitor. Ranges in both of the cases mentioned are sold at list prices.

Studying Power Costs for Steam Laundries

This Class of Business Offers Possibilities to Central Stations and Can Usually Be Served by Lines Already Constructed

BY P. P. PINE

Commercial Department San Diego (Cal.) Consolidated Gas & Electric Company

ONE of the most common of the industries which obtain their power from isolated plants is the steam laundry. Since relatively few of these have installed central-station service, this is a source of new business which offers great possibilities to the commercial department of practically every central station. This business is very desirable as the load factor is high and constant throughout the year. Furthermore, as most laundries are located along existing lines very little additional investment is required to handle the load.

The first obstacle which the central-station power salesman must overcome when he endeavors to secure the business is, "How is the wash water to be economically heated?" The laundry owner will probably assert that his power costs him nothing because he has to have steam to heat water anyhow and can just as well take it from the engine exhaust. The securing of the laundry business then hinges on the proposition: Can sufficient fuel be saved to pay the cost of electric energy? If this can be done, the many advantages incident to the use of electric drive will quickly cause most laundry owners to substitute electric power. One method of figuring the theoretical cost of power where all of the engine exhaust is utilized in heating water is as follows:

Assumptions:

A 30-hp. engine of the Atlas type operating at an average load of 15 hp.

Steam consumption, 65 lb. per brake-horsepower-hour.

Evaporation of boiler, 10 lb. water per pound of oil.

Absorption of heat by engine (as found by barrel calorimeter method), 20 per cent of total heat received.

Cost of oil, $1.75 per barrel (at 315 lb. per barrel) = $0.0055 per lb. (This is equivalent to coal of 10,000 B.t.u. costing $4 per short ton, or coal of 14,000 B.t.u. costing $7 per short ton.)

Calculation:

Steam consumption of engine = 65 lb.×15 = 975 lb. per hour.

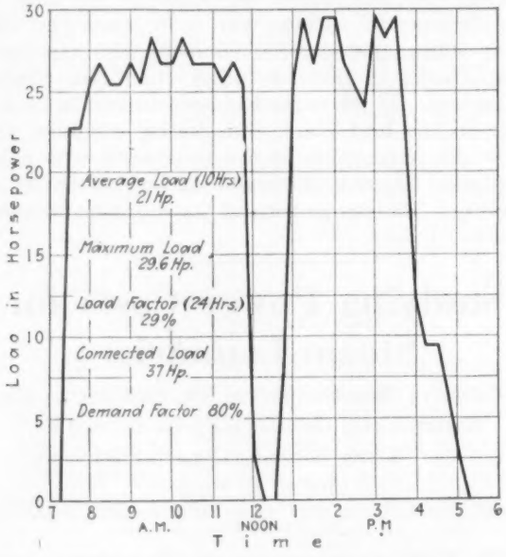
Steam equivalent of heat absorbed by engine = 20 per cent×975 lb. = 195 lb. per hour.

Fuel cost of evaporating 1,000 lb. of steam at 10 lb. evaporation = 100×$0.0055 = $0.55.

Equivalent cost of fuel for heat absorbed by engine = 195÷1,000×$0.55 = $0.107.

Cost of fuel per brake-horsepower-hour = $0.107÷15 = 7.15 mills, or 9.6 mills per kw.-hr.

About two years ago one of the prominent laundry men of San Diego requested that a test be made of his plant and an estimate submitted on cost of operation



LOAD CURVE FOR A LAUNDRY HAVING A CONNECTING LOAD OF 37 HP.

with electric drive. His boiler capacity was not sufficient to carry the load. As he was contemplating the building of a new plant, he did not wish to install another boiler at the old location. It was found that a 20-hp. motor would handle the load. As the prospective customer was paying only $1.20 per barrel for fuel oil at that time, his fuel cost for power was calculated to be about 6.6 mills per kilowatt-hour. He was already using central-station service for heating flatirons. By changing to motor drive he would be able to guarantee $75 a month and earn a net rate of 2 cents per kilowatt-hour.

As he would not be able to save anything on labor costs, it seemed that electric drive would cost considerably more than steam. However, without making an estimate of the cost, the power company offered to install a motor on two months' trial and if it was not satisfactory to remove it and charge him only a nominal sum for the installation and use of the electrical equipment. This proposition was accepted and the motor installed. In order to make as good a showing in oil saving as possible, the steam-piping system was overhauled. It was found that some of the collar and other small steam-heated machines exhausted directly into the atmosphere. This steam was piped to the wash-water tank. Other changes were made, with the result that practically no live steam was needed to heat the wash water. For this reason, practically all the steam was saved that had formerly been sent to the engine.

After three months' operation, the comparative cost of power was found to be as follows:

215	barrels of oil used per month when operating steam engine.
131	barrels of oil used per month after motor was installed.
84	barrels of oil saved per month.
$100.80	saving in fuel cost (oil at $1.20 per barrel).
57.17	Electric power cost per month at 2 cents per kw.-hr.
43.63	net saving per month.

This installation has been in operation for about two years, and although another boiler has been installed, the engine has not been turned over since the day the motor was put in.

After finding that electric drive had made such a showing in this laundry, a drive was started to obtain more of this business. Six small-sized and three large laundries have now shut down their steam engines and installed motors. Electricity has proved satisfactory and economical in every case. In two instances it was found that the fuel saving was sufficient to pay double the electric power bill.

SAVING OF $60 A MONTH IN FUEL OIL

In one of the large laundries which have discontinued engines and installed motors the first month's operation showed no saving in fuel oil. The reason was that the piping had not been changed so as to utilize properly the exhaust steam from the mangles and other steam-consuming appliances. After these changes were made, the second month's operation of the motors not only showed enough oil saved to pay the power bill but netted about $60 over and above this cost.

It will generally be found that the large laundries are being operated more efficiently than the smaller ones. The steam wasted owing to the exhaust escaping directly into the air, uncovered pipes and poor engineering in general is a smaller proportion of the total steam generated in the large laundries than in the small ones.

At the prevailing high costs of fuel it will be found that central-station service is able to compete with the fuel cost of power in many industries utilizing the exhaust steam for heating. This will be found to be particularly true where hydro-electric power is used. It is not necessary to make a sufficient saving in fuel to cover the power bill. With electric drive throughout much less time is required of the fireman or engineer, especially where coal is used as a fuel. The time thus saved can be very profitably devoted to other useful purposes.

It will be found that in many cases the engines or boilers are overloaded, causing very poor speed regulation. In such instances motor drive will increase the capacity of the entire plant. This advantage will more than compensate for a higher power cost, so that whether or not a saving can be effected by changing to central-station service is not always the determining factor. Another important feature to be considered where it is economical to discontinue the steam engine and adopt motor drive is the conservation of fuel.

Marks of Courtesy That Build Good Will

THE forms shown are two of those used by the Southern California Edison Company for inclosing with copies of bills sent to consumers. They illustrate the courteous manner in which the Southern California

We acknowledge with thanks the favor of your remittance which has been credited to your account.

Southern California Edison Company

DIGNIFIED ACKNOWLEDGMENT OF PAYMENT

FORM C-814 1. M 8-19

IN SUBMITTING THE ENCLOSED BILL THE FINAL ONE FOR YOU AT THAT ADDRESS, THE SOUTHERN CALIFORNIA EDISON COMPANY TAKES THIS OPPORTUNITY OF STATING THAT IT HAS ENJOYED THE PLEASANT RELATIONS WHICH HAVE EXISTED IN THE PAST AND HOPES THAT THEY MAY SHORTLY BE RESUMED, IF NOT IMMEDIATELY AT SOME OTHER LOCATION, PERHAPS AT A LATER DATE WHEN YOU MAY AGAIN BE IN NEED OF ITS SERVICE.

THIS MESSAGE GOES OUT WITH THE FINAL BILL

Edison Company deals with all of its customers. The sentiment expressed is not merely superficial but is backed up by the attitude of the employees of the company who come in contact with the public.

Domestic Refrigerator Earns Most Per Kilowatt Demand

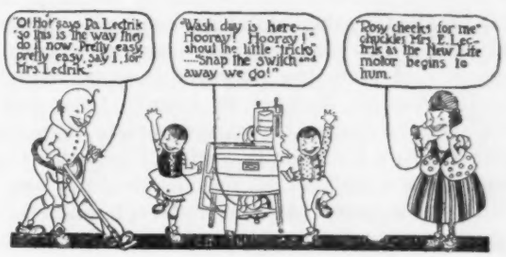
"CENTRAL stations generally consider the most desirable power customer to be the one paying the largest bill per kilowatt demand, and if household electric appliances were compared on the same basis, their relative desirability could be more intelligently determined," said Robert Montgomery, commercial manager of the Louisville (Ky.) Gas & Electric Company, in a paper read before the Commercial Section of the Indiana Electric Light Association at Fort Wayne, Ind. "However, the time of day and season of the year that the appliance is used should also be considered. A central station must as a rule spend more than $100 for increasing the capacity of the meter, service wires and transformers before service can be furnished to a range; but a domestic refrigerating machine, which yields almost ten times the revenue per kilowatt of demand, requires no investment of this nature on the part of the company."

ANNUAL REVENUE PER KILOWATT OF DEMAND FOR VARIOUS ELECTRIC APPLIANCES

Appliance	Maximum Demand, in Watts	Annual Kw.-Hr. Consumption	Equivalent Hours' Use of Demand	Rate Per Kw. Hr.	Annual Revenue	Annual Revenue per Kw. of Demand
Refrigerator	300	864	2,880	$0.0325	$28.08	$93.60
Fan	40	31	775	.084	2.60	65.00
Radiator	600	96	160	.084	8.06	13.43
Cleaner	170	25	147	.084	2.10	12.35
Percolator	400	42	105	.084	4.03	10.07
Iron	575	67	116	.084	5.62	9.79
Range	5,000	1,500	300	.0325	48.75	9. 5
Toaster	500	37.5	75	.084	3.15	6.30
Grill	500	34	68	.084	2.85	5.70
Washer	300	20	66	.084	1.68	5.60

In the appended tabulation, showing the average annual revenue per kilowatt of demand for various electric appliances, 8.4 cents is assumed to be the average lighting rate throughout the United States and 3.25 cents the average cooking rate. The refrigerating machine, owing to its high load factor, is assumed to earn the same rate as the electric range.

Advertising a Washing-Machine Campaign


"Oh Horsey says Pa Lectrik so this is the way they do it now. Pretty easy, say I, for Mrs. Lectrik."
"Wash day is here—Hooray! Hooray!" shout the little "tricks" —"Snap the switch and away we go!"
"Now cheer for me" chuckles Mrs. E. Lectrik as the New Life motor begins to hum.

Here They Are Again!

Pa E. Lectrik, Ma E. Lectrick and the little Tricks—all ready to show you how to have the help and happiness of **COMPLETE ELECTRIC SERVICE IN THE HOME.**

And after this whenever and wherever you see the E. Lectricks you will know they stand for all that COMPLETE ELECTRIC SERVICE IN THE HOME stands for—comfort and cleanliness, less work and worry and a saving of food, fuel, time and money.

"For," says Ma E. Lectrick, "you've no idea how simple and really economical electric service is. It's better than any hired girl because it does so many things at once and it's always ready. It cooks and sews and washes and irons and cleans—all so quickly that I have plenty of time to enjoy myself with Pa E. Lectrick and the little Tricks. And then," beams Ma, "there's always my electric vibrator to keep me perked up and looking my best."

"Remarkable," adds Pa E. Lectrick. "Remarkable and very reasonable, too, say I, with the easy payments and the thrifty operation."
"Just a snap!" shout the little Tricks.

During the month of March you can buy an Automatic Washer for $5 down and $5 a month, and it costs only 1½ cents an hour to operate.

We will be pleased to demonstrate any of the new electrical appliances that so cheaply contribute to the happiness and comfort of the home.

Utah Power & Light Co.

"Efficient Public Service."

Kearns Building. Wasatch 500

THIS is a type of advertising used by the Utah Power & Light Company, Salt Lake City, Utah, during a recent washing-machine campaign. As a result of this campaign more washing machines were sold in one month than had been sold in two months of the year previous. The company now boasts one washing machine for every five resident customers on its lines. The campaign is being continued and it is the expectation of the company that this record will be exceeded during the coming season.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

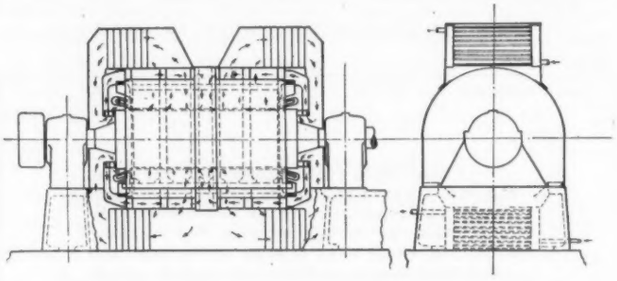
Generation, Transmission and Distribution

Hydraulic Shocks in Power-Station Conduits.—The problem of calculating the pressure rises caused by hydraulic surges, or water hammer, in the conduits of hydro-electric power stations has of late received much attention among French scientists and engineers. When the inlet to a water turbine, fed through a long tubular conduit, is suddenly closed, a pressure wave arises, which travels along the conduit and undergoes reflection at discontinuities and at the point where the conduit terminates in the upper reservoir. By superposition of pressure waves overpressures sometimes occur which may endanger the turbines and the walls of the conduit. An important paper by Camichel, Eydoux and Cariel (*Revue Générale d'Electricité*, Feb. 15, 1919) deals with the theoretical aspects of this problem, and contains also a report on some interesting experimental researches on pressure shocks in actual conduits. In a series of notes to the French Academy Count de Sparre gives a detailed mathematical analysis of a number of special cases which may occur in practice. (These notes are reproduced from the *Comptes Rendus*, 1917-18, in *La Houille Blanche*, January to August, 1919, and have recently been collected in more complete form in the *Bulletin Spéciale No. 2 de la Société Hydrotechnique de France.*) For construction reasons conduits are often built in two or more parts of different diameters and wall thicknesses. De Sparre's theory indicates that in a two-part conduit the maximum pressure rise may be 40 per cent higher, and in a three-part conduit as much as 65 per cent higher, than in a similar homogeneous conduit. In a recent article (*Revue Générale d'Electricité*, Nov. 29, 1919) de Sparre finally investigates the case of a conduit of a great number of parts, corresponding to the case where diameter and thickness vary linearly along the tube. E. Carey (*Revue Générale d'Electricité*, Oct. 25 and Dec. 6, 1919) takes up similar problems in connection with discontinuous conduits and offers a great number of curves from which the overpressure may be determined for different cases. If the conduits contain airpockets, oscillations *en masse* may arise, which, through resonance, sometimes give rise to dangerous overpressures of another sort. The latter have been studied by Camichel (*Houille Blanche*, September-October, 1919) and also by Foch (*Comptes Rendus*, Sept. 19, 1919).

Installations, Systems and Appliances

The Evolution of the Electric Brass Furnace.—H. M. ST. JOHN.—The evolution is considered from the standpoint of the survival of the fittest. The furnaces are classified as (1) induction or direct-resistance furnaces, in which heat is generated by the direct resistance of the metal itself; (2) indirect-resistance furnaces, in which heat is generated in a resistor and transferred by radiation or conduotion to the metal to be heated, and (3) arc furnaces, in which heat is transferred to the metal directly or indirectly by conduction or radiation. The various types of brass-melting furnaces are discussed under these three heads.—Paper presented at meeting of American Electro-Chemical Society, Boston, April 8, 1920.

Investigation of Water-Air Radiators for Cooling Generators and Motors.—H. G. REIST and E. H. FREIBURGHOUSE.—It is pointed out that in the case of electrically driven ships the usual method of washing the ventilating air for turbo-generator units cannot be applied on account of the space limitations on shipboard.



VENTILATION OF A TURBO-ALTERNATOR BY COOLING AIR THROUGH A WATER RADIATOR

The plan of circulating salt water through a radiator much on the order of the automobile radiator and cooling the hot ventilating air by this means has been investigated by the authors. Considerable data and curves are given to show the advantages of this method where space is limited.—*General Electric Review*, February, 1920.

The Working of Mercury Rectifiers.—E. CARLEVARO.—Opinions do not agree as to the dependence of the efficiency of mercury rectifiers upon the form of the curve, some experimenters concluding that the two quantities are independent while others conclude the opposite. The author has therefore made a methodical and long series of experiments in order to throw light upon the working of the apparatus. The different forms of alternating curves were obtained from two alternators mounted on the same shaft, the frequency of one being three times that of the other. The windings were connected in series, and the phase of the third harmonic was varied by shifting the stator of the triple-frequency alternator. The changing of the excitation of the latter alternator produced the change of amplitude of the third harmonic. The efficiency of the mercury rectifier fed by sinusoidal current was found to be practically constant for loads varying from one-third to full load; for very small loads it is higher; for loads larger than the normal one it diminishes. The mean voltage drop in the arc was found to be 13 volts. The efficiency varies according to a linear law with the potential difference. Consequently the efficiency of mercury rectifiers increases when the primary potential difference increases. The frequency, within the ordi-

nary practical limits, has no influence upon the efficiency. The form of the alternating-current curve was found to have only a slight influence upon the efficiency; in particular, with a rectangular curve the efficiency is slightly greater. Stroboscopic observations of the arc showed that its lighting and extinction take place extremely rapidly, and that the arc lasts a little more than half a period.—*Science Abstracts, Section B*, Aug. 30, 1919. (Abstracted from *Elettrotecnica*, June 25, 1919.)

The Specification of Alternating-Current Switchgear.—A. E. VAN DAVIES.—Specifications for the electrical equipment of a generating plant with the present capacity of 5,000 kw., but which is expected to reach a capacity of 25,000 kw. in the next ten years, are given for the alternating-current switchgear. The writer gives reasons for the specifications as drawn up.—*Transactions of the South African Institute of Electrical Engineers*, December, 1919.

A Study of the Deterioration of Nickel Spark-Plug Electrodes in Service.—HENRY S. RAWDON and A. I. KRYNITZKY.—Some unusual as well as some more common types of deterioration which occur in nickel spark-plug electrodes are described. An intercrystalline brittleness is produced in service in the surface metal exposed to the hot gases and to the action of the spark. Sometimes definite "knife-cut" breaks occur in the wire. The brittleness is due to the action of hot reducing gases and to local heating of small areas. The greatly reduced strength of nickel wire when hot permits breaks to occur in electrodes by the relatively slight tensional stresses set up in service. This is particularly true of electrodes which are firmly anchored at both ends.—*Technologic Paper No. 143, United States Bureau of Standards*, Jan. 22, 1920.

Electrophysics and Magnetism

Solid Versus Stranded Wire for High Frequency Coils.—W. ROGOWSKI.—At ordinary frequencies stranded wire will give less resistance than solid wire of the same copper area. At a certain frequency, however, the stranded wire will give just as high resistance as corresponding solid wire, and at still higher frequencies the solid wire will have the lower resistance. For example, a coil of high-frequency cable made of forty-eight strands of No. 38 copper wire will at about 400 m. wave length have the same resistance as a similar coil of corresponding-size solid wire. Such a stranding should therefore not be used for shorter wave length than 400 m. This follows from a formula presented by the author in an earlier paper. Considering instead a constant frequency and constant number of strands, the author shows that a sharply defined minimum of resistance occurs at a given diameter of strands. At 1,000 m. wave length for instance and eighty-one strands, No. 36 or No. 37 wire will give minimum resistance, a heavier or finer strand giving higher resistance. At this minimum point the skin effect resistance ratio is just 1.5, corresponding to a 50 per cent increase over direct-current resistance.—*Archiv für Elektrotechnik*, Nov. 10, 1919.

Constants of Radiation of a Uniformly Heated Inclosure.—W. W. COBLENTZ.—A recalculation is given of data previously published (Scientific Papers Nos. 261 and 262). The new value of the coefficient of total radiation is $\delta = 5{,}722 \times 10^{-12}$ watt cm.$^{-2}$ deg.$^{-4}$, which is in agreement with the value previously published. Experimental data are given on the absorption of dry and humid air. The effect of atmospheric absorption is discussed and it is concluded that, if corrections are made for absorption by water vapor, the value of δ obtained recently at Naples is close to the average value. $\delta = 5.7$.—*Scientific Paper No. 357, United States Bureau of Standards*, Jan. 16, 1920.

Telegraphy, Telephony and Signals

Portable Radio Apparatus Used by the German Army.—A. SALOMON.—In a profusely illustrated article a great number of different types of portable radio outfits are described such as were used in the German army during the war. Although the paper is too rich in detail to permit abstracting, there are certain outstanding features of design which should be noted. The transmitters were mostly of the multi-gap, quenched-spark type, fed either from an audio-frequency generator, with resonance transformer, or from storage batteries, by means of a spark coil with a special type of oscillating interrupter. This device appears in a good many German transmitter designs for radio and ground telegraphy, and consists of a polarized bipolar interrupter so arranged that the moving contact, in oscillating between two fixed contacts, not only breaks but actually reverses the primary current of the spark coil, thus enabling a utilization of the steepest parts of the hysteresis curves of the core. Most of the receiving sets employ ordinary detectors, but in recent types vacuum tubes are used for detection and amplification. Common to almost all German tube-sets is the iron filament resistance, consisting of a small coil of fine iron wire inclosed in a vacuum tube. The resistance of such a unit is rather low up to a certain strength of current, when it rapidly attains very high values. An iron-wire tube therefore will hold the filament current constant within certain limits, even though the battery voltage may change over a relatively wide range. It will also prevent accidental filament burnouts, since it constitutes an extremely effective fuse.— *Revue Générale d'Electricité*, Dec. 13, 1919.

Miscellaneous

Energy Storage and Utilization of Idle Electric Power for Heating Purposes.—W. DAHLGREN.—Usually consumption of electric power is paid for according to some such formula as $A + B$ + kw. + C + kw.-hr. The first two terms are determined only by maximum demand, which is usually reached during at most two or three thousand hours a year. It is therefore clear that any consumption of electric power below the maximum paid for during the remainder of the 8,760 hours of the year will be paid for at a very low rate. This is particularly, and justly, the case when the energy is supplied from hydraulic stations. The author develops a method of storing the surplus energy by heating during idle hours the water in a big hot-water tank. The accumulated energy then may be utilized to heat the buildings during daytime. It is shown that if the constant C is 0.01 kr. (¼ cent) per kilowatt-hour, this electric heating system will be more economical than steam heating with coke if the price of coke is more than 52.4 kr. (about $12) per ton, and even where conditions seem rather adverse to electric heating the results secured from the heat-storage system show surprisingly good figures.—*Teknisk Tidskrift Elektroteknik*, Feb. 4, 1919.

Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

Research in Progress or Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

MACHINERY, ELECTRICAL, VENTILATION OF.

While the output of electrical machinery has been increased considerably during the past decade by the use of more efficient ventilation, considerable further improvement is possible in this direction. Very little is known regarding the fundamental laws governing the design of various types of blowers, especially of those types which are adapted for machines operated in either direction of rotation. Systematic studies along this line would be of great benefit to the art.—*R. E. Hellmund, Pittsburgh, Pa.*

MAGNETOS, CIRCUIT BREAKERS FOR.

Oscillographic tests indicate that there is a certain amount of mechanical chance in the best constructed and adjusted circuit breakers used in ignition magnetos. Considerable research and real invention are needed to improve them.—*F. W. Springer, University of Minnesota, Minneapolis, Minn.*

MOTORS, DIRECT-CURRENT, SERIES WOUND, CONNECTED IN PARALLEL.

In some industries, especially in steel mills, two series motors are sometimes used—mechanically interconnected and electrically connected in parallel. When a common starting resistance is used for the two motors, large circulating currents are sometimes observed, due to a slight difference in the saturation curves of the machines. A practical remedy is desired for this difficulty.—*Editorial Suggestion.*

SWITCHES, EXTRA-HIGH TENSION.

In a paper on "Problems of 220-Kv. Power Transmission," presented before the last A. I. E. E. convention (*Proceedings*, 1919, p. 802), A. E. Silver recommends that all line switching, both automatic and manual, should be done on the high-tension side of the transformers. He believes that with enormous currents involved on the low-tension side high-tension switching will be both simpler and safer. Experiments are desired that will lead to the development of 220-kv. disconnecting switches and circuit breakers, in anticipation of a project involving such voltages.—*Editorial Suggestion.*

TELEPHONE, AUTOMATIC, RATCHET ACTIONS.

Automatic ratchet actions might be further studied, their structure, power required, safeguards for accuracy and prevention of wear, together with the relative merits of magnetic drive and spring drive. The driving of the moving part is accomplished either by the forward stroke of the magnet or by the return stroke.—*A. B. Smith, Chicago, Ill.*

TELEPHONE TRANSMITTER, DIAPHRAGM ACTION.

There is no complete theory available of the microphone diaphragm that would take into account the mode of its fastening, the damping springs and the variable pressure of the carbon capsule. Such a theory substantiated by accurate experiments would tend to place the transmitter design upon a more rational and quantitative basis such as has been attained in some other branches of electrical engineering.—*Editorial Suggestion.*

RELAY, FOR AUTOMATIC SUBSTATION.

In connection with our automatic railway substation we need an accurate timing device for dropping the substation off the line when there is no further demand for it. The present relay, which is an oil-dashed box, is unsatisfactory on account of the variable time element due to temperature. We have in mind to develop an induction-type relay, because I do not believe that either of the present forms of relays—that is, the one driven by a little direct-current motor, or the oil-dashed box—will be satisfactory. I am certain that control must be from the alternating-current side, as the small direct-current motor will be subjected to too many electrical disturbances, like lightning.—*J. M. Drabelle, Iowa Railway & Light Company, Cedar Rapids, Iowa.*

TELEPHONE NETWORKS OF MAXIMUM OUTPUT.

Four resistances may be so connected by ideal transformers that each resistance will have the maximum possible output into the remaining three resistances. It has been found that in such circuits the resistances must be conjugate in pairs; that the minimum number of elements required for the general case is six windings, three on each of two transformers; that the number of distinct networks is 57,340, all of which are equally unrestricted; that the number of special cases in which restrictions as to the distribution of the input, the magnitudes of the resistances and the directions of current flow are permitted is 577,722. The properties of these circuits have been investigated, together with those of related circuits having either a larger or a smaller number of elements. The application of these networks to telephone substations and repeater circuits has been specially considered.—*George A. Campbell, American Telephone & Telegraph Company, New York City.*

WELDING, METALLIC ARC.

In this kind of electric welding a metal electrode is used of approximately similar material to that being welded. Extensive tests have been made at different places in this country and in England regarding the best conditions for producing a first-class uniform weld under the actual working conditions in a shipyard. The following factors were investigated in particular: (1) The type of electrode, *i.e.*, bare metal or covered; (2) chemical composition of the electrode; (3) chemical composition of the metal being welded; (4) size of electrode; (5) kind of current, *i.e.*, alternating or direct; (6) amperage and voltage; (7) skill of the operator; (8) method of preparing and building up the joint. Much of the work had to be carried on under the trying war conditions, and a great deal of important fundamental research remains to be done.—*Welding Committee of Emergency Fleet Corporation.*

AERIALS, COIL-TYPE, USE OF.

Coil aerials are coming to replace the large antennas in radio work. The advantages of the coil aërial as a direction finder, interference preventer, reducer of strays and submarine aërial make it important to know how effective such an aërial is as a transmitting and receiving device in comparison with the ordinary antenna. A mathematical theory has been developed and experiments have been performed which have verified the conclusions reached so that the formulas obtained are a valuable aid in the design of an aërial to fit any kind of radio station. It is found that the coil aërial is particularly desirable for communication on short wave lengths. A coil aërial is as powerful as an antenna only when its dimensions approach those of the antenna. For other reasons, however, a small coil aërial is in many cases as effective as a large antenna.—*J. H. Dellinger, Bureau of Standards, Washington, D. C.*

GLASSES, COLORED, ULTRA-VIOLET, AND VISIBLE TRANSMISSION OF.

During the last three years the spectral transmissions of a great number and variety of glasses have been measured throughout the ultra-violet, visible and infra-red parts of the spectrum. Such data have been collected for a large number of American and imported samples of glass, so that it is possible to compare their relative merits.—*K. S. Gibson, E. P. T. Tyndall, H. J. McNichols, Bureau of Standards, Washington, D. C.*

INDUCTION, ELECTROMAGNETIC, AND RELATIVE MOTION.

In the *Physical Review* for August 1918, S. J. Barnett describes an experiment which at first sight appears to show that the uniform rectilinear motion of a magnet is not accompanied by an electric field such as would be given by the "moving-line theory." The experiment consists in an attempt to charge a condenser by causing an electromagnet to swing past it. The condenser and the remainder of the insulated system were, however, shielded by a brass case to protect them from electrostatic effects. An investigation has been made by the present writer to show that the electric field which the moving-line theory would predict as operative under the conditions prevailing in Barnett's experiment is of a type derivable from a potential of origin external to the brass case. Thus, under the influence of this potential, the case assumes a charge distribution whose field at all internal points just annuls that due to the moving lines. In other words, the case wards off the effect.—*W. F. G. Swann, University of Minnesota, Minneapolis.*

INSULATING MATERIALS, THERMAL EXPANSION OF.

Experimental data have been obtained on a few materials possessing irregular or unusual expansive properties. In most cases the expansions are too irregular to justify the use of the general quadratic equations. A knowledge of the thermal behavior of these materials is essential before assembling them in certain types of apparatus subjected to wide temperature variations. The most striking peculiarities are: (a) The wide range in the values of the co-efficient of porcelain (from 1.6 to 19.6 millionths per unit length per degree Centigrade); (b) the three varities of expansions for porcelain, namely, straight line, concave and convex expansion curves; (c) the shrinkage and the loss in weight of the phenol and similar compounds when subjected to excessive heat treatment; (d) the permanent growth and variations of different marbles when subjected to heat treatment; (e) the negative co-efficient of expansion of marble at low temperatures.—*W. H. Souder and P. Hidnert, Bureau of Standards, Washington, D. C.*

SPARK PLUG ELECTRODES, DETERIORATION OF.

The electrodes of spark plugs are usually made of commercial nickel wire, 97 per cent grade being a common material. After considerable service the electrodes show crystallization and cracks of various types. The following factors have been found to have a tendency to make the electrodes brittle: Continuous heating for several days at a high temperature (approximately 850 deg. C.), heating in reducing gases similar to those encountered in service, and intense local heating by means of the electric spark. The central electrode is found to deteriorate much less than the side ones. The latter, when anchored at both ends across the shell of the plug, are subject to tensional stress due to the differential expansion of the shell, and hence the cracks develop quite readily. Evidently this deterioration of nickel wire is a characteristic behavior of this material at high temperatures.—*H. S. Rawdon and A. J. Krynitzky, Bureau of Standards, Washington, D. C.*

PAINT, WHITE LEAD, SPECIFICATION STANDARDIZATION OF.

A specification has been prepared of the chemical and physical requirements for dry basic carbonate white lead and basic carbonate white lead ground to a paste in linseed oil. Methods of sampling and of testing both dry pigment and paste are included. This specification is recommended by the United States interdepartmental committee on paint specification and has the approval of the Paint Manufacturers' Association.—*Bureau of Standards, Washington, D. C.*

INSTRUMENTS, MEASURING, ACCURACY SPECIFICATION FOR.

There should be an American specification for instrument accuracy like the one by the British engineering standards committee.—*H. B. Brooks, Bureau of Standards, Washington.*

Books of Technical and Industrial Interest

OIL ENGINES. By L. H. Morrison. New York: McGraw-Hill Book Company. 459 pages, 21 tables, 357 illustrations.

Owing to the extensive application of oil engines to various purposes and the necessity of intelligent operation of these engines if the fast-decreasing oil supply of this country is to be conserved, any work that gives more than the mere construction details of oil engines is welcome at this time. In addition to the details of construction of the more important types of oil engines on the market, this volume explains how to make adjustments so that the most satisfactory operation will be obtained. The author's relation with the government should afford him an impartial viewpoint. After giving a brief historical outline of the development of oil engines he considers various modifications of Diesel, semi-Diesel and low-compression oil engines, first giving the details of installing an oil machine. Then the features of the different parts of each machine are described, means of avoiding trouble are outlined, methods of adjusting parts are explained and procedures in making some major repairs are suggested. Methods of determining the performance of engines are explained, comparative operating costs are given, and data on air pressures, cooling-water temperatures, amount of lubrication and characteristics of fuel oils are presented. Particular attention is given to valves and auxiliary equipment such as fuel pumps, air compressors, cooling and lubricating systems. The chapters on fuel consumption and operating costs are particularly interesting.

CONTROLLERS FOR ELECTRIC MOTORS. By H. D. James. New York: D. Van Nostrand Company. 351 pages, 259 illustrations.

This volume consists of a series of articles originally published in the *Electric Journal* to which have been added some new text and illustrations. It is particularly adapted to give a general idea of industrial controllers and to explain their principles of operation. The first half of the book deals chiefly with elementary phases of the subject, such as fundamentals, historical development, operation of three general types of controller (face-plate, drum, magnetic), methods of securing automatic acceleration, starting characteristics of motors, methods of speed control, principles of direct-current and alternating-current magnetic controllers, application of resistors, nature of different protecting devices and series-parallel control. Instead of considering specific makes of apparatus the author refers to fundamental principles. This is one feature of this book particularly to be commended. The last half of the book is devoted to practical applications of control apparatus, mine hoists, pumps, machine tools, machines requiring low initial speed, steel-mill auxiliaries, cranes, car dumpers, ore and coal bridges, elevators, oil-well operations, mine locomotives, etc. While some specific data would add to this section of the volume, it serves a very useful purpose in giving a good general knowledge of what types of apparatus are available and suitable for different purposes and what their relative advantages and disadvantages are. Every one who is interested in industrial applications of control will benefit by reading this book by one of the foremost authorities on electrical control.

ELEMENTS OF ELECTROMAGNETIC THEORY OF LIGHT. By Ludwik Silberstein, New York: Longmans, Green & Company. 48 pages.

This little volume is more than merely a neat exposition of the electromagnetic theory of light based on vectorial notation; it is a brief review of the essentials and difficulties of optical theory as developed in the last three-quarters of a century. The earlier treatments of the subject were based on hypotheses regarding the dynamics of the ether, and their intricacies reflect the uncertainties of our knowledge. Maxwell's theory, later amplified by others, evades rather than explains these almost insoluble problems by referring the solution to the electric and magnetic forces which act through matter in ways which are at least definite and analyzable, irrespective of molecular dynamics. We are now perhaps approaching a stage of investigation in which the two may be tied together by clearing up the dynamical relations of the dielectric constant, which seems to be the point of contact between the old theories and the new. Until that is done the electromagnetic theory must hold the field as such, a beautiful example of the proximate solution of a transcendently difficult problem by a brilliant attack along the line of least resistance. Professor Silberstein's book is not one for the tyro, but will be found stimulating and helpful to those who need an efficient introduction to optical theories in their broadest aspect and are willing to follow up the advantage thus gained.

Books Received

ANALYSIS OF BABBITT. By James Brakes. Troy, N. Y.: Allen Book & Printing Company. 170 pages.

MECHANICAL WORLD YEAR BOOK, 1920. Manchester, England: Emmott & Company, Ltd. 665 pages, illustrated.

ELECTRIC LIGHTING. By Olin Jerome Ferguson. New York: McGraw-Hill Book Company, Inc. 244 pages, 104 illustrations.

SCHOOL OF PRACTICAL ELECTRICITY. By O. Werwath. Milwaukee, Wis.: Electroforce Publishing Company. 60 pages, 110 illustrations.

GOVERNORS AND THE GOVERNING OF PRIME MOVERS. By W. Trinks. New York: D. Van Nostrand Company. 236 pages, 139 illustrations.

PRINCIPLES AND PRACTICE OF ELLCTRICAL TESTING. By R. G. Allen. New York: Longmans, Green & Company. 364 pages, 286 illustrations.

IONS, ELECTRONS AND IONIZING RADIATIONS. By James Arnold Crowther. New York: Longmans, Green & Company, 276 pages, 95 illustrations.

ARMATURE WINDING AND MOTOR REPAIR. By Daniel H. Braymer. New York: McGraw-Hill Book Company, Inc. 500 pages, 300 illustrations.

THE PRINCIPLES OF ELECTRICAL ENGINEERING AND THEIR APPLICATION. By Gisbert Kapp. New York: Longmans, Green & Company. 388 pages, 175 illustrations.

News in Brief

SUMMARY

of Important Happenings in the Industry During the Week

NEW building construction, which has started at a good rate in nearly all sections of the country, will suffer seriously if the present railroad tie-up continues for another week. Improvement in traffic conditions, however, is reported from Chicago and other points in the Middle West.

JOBBERS as a whole in the affected regions are going to be hard put to it in a short time to fill any sizable orders on the general run of wiring supplies, except wire. Stocks are low as a consequence of the condition of transportation during the winter and the inability of manufacturers to fill orders, and the halt in rail and water transit has made matters extremely serious. Both manufacturers and jobbers are moving material, raw and finished, by motor truck, and some little relief is afforded in this way. Manufacturers are short of raw materials, coal and coke, and many steel mills are being forced to close.

FEW PRICE changes have come through this week, but more rigid-conduit mills are reported on card 45 and at least one manufacturer of flexible armored conductor has increased his price $5 per 1,000 ft.

A PROMINENT New England manufacturer has cut out the production of some lines to concentrate on a few, expecting thereby to render better service at a lower cost.

DURING February an improvement was shown in the value of electrical exports. The total amount was $6,583,228, or almost $250,000 above the figures for January. The total for 1920 is averaging only $10,000,000 below the record year of 1919.

WORK on the Tugaloo hydro-electric development of the Georgia Railway & Power Company, which has been suspended for eighteen months because of post-war developments, is being resumed.

OWING to the difficulty of financing development, the Consolidated Light, Heat & Power Company of Huntington, W. Va., has entered into a contract with the Virginian Power Company of Charleston, W. Va., for a ten years' supply of commercial power.

A WIRELESS dispatch to the ELECTRICAL WORLD from Brussels, Belgium, records progress made by the advisory committees of the International Electrotechnical Commission. A special committee is to begin at once a comprehensive vocabulary of essential electrical terms. The American delegates' plan for fixing temperature limits was indorsed.

FIFTY papers were presented at the annual convention of the American Electrochemical Society, held jointly at Boston with the A. I. E. E. and the Electric Furnace Association. The development of electric furnace applications was the chief topic of discussion. W. S. Landis was elected president of the American Electrochemical Society and Acheson Smith of the Electric Furnace Association.

NEW JERSEY has defeated and Massachusetts has adopted a daylight-saving bill.

IN COMPANY with all industry, the electrical companies have been affected by the "outlaw" railroad strike, but they are coming through the disturbance well. Central stations in the East for the most part have good coal reserves, but fuel scarcity is acute in Detroit, Toledo and Columbus. Raw material is running out in New England, and manufactured stocks everywhere are accumulating.

THE STRIKE of 326 employees of the Pacific Gas & Electric Company in California still continues. One hundred electrical workers are out in Salt Lake City, Utah.

ILLINOIS public utilities may be forced by the high cost of money to abandon a program of improvements which would involve a total expenditure of $100,000,000.

A REFERENDUM on the establishment of a federal Department of Public Works, to combine the engineering and construction activities of the government, has been ordered by the Chamber of Commerce of the United States.

ON MONDAY next the joint engineering societies of Chicago will be addressed by the presidents of the four large national engineering bodies at a dinner to be held in the interests of professional upbuilding.

CHICAGO voters defeated four proposed bond issues this week, including one of $15,000,000 for extending the electric street-lighting system. The public affairs committee of the Western Society of Engineers had recommended the defeat of the measures.

THE FIRST units for the new Calumet power station of the Commonwealth Edison Company, Chicago—two 30,000-kw. turbines—have been ordered. It is the expectation that the station will be ready for opening in the fall of 1921. Its capacity is to be greatly augmented later.

WITH only one exception the power companies of California have signed an agreement whereby the State Railroad Commission is to frame rules for the distribution of electrical energy. H. G. Butler has been appointed state power administrator by the commission.

COMPLETION of the state-wide plan of interconnection in California is expected by May 1, when ninety-two steam and hydro-electric plants will be tied into one system with a daily load of 10,000,000 kw.-hr.

ELECTRIC drive and the Diesel engine will be developed by the United States Shipping Board in the merchant marine as conducing to motive power of the best efficiency.

BALLOTING for officers of the A. I. E. E. is now proceeding. Results will be announced at the annual business meeting in May.

PRESENTATION of the Edison medal to W. L. R. Emmet of Schenectady, to whom it was awarded last December, will be made on May 21.

OFFICIAL reports show that 72.7 per cent of the developed water power of Canada is utilized by electric central stations.

EXISTING high prices for bituminous coal are, in the opinion of Herbert N. Stenton, secretary of the United States Bituminous Coal Commission, absolutely unwarranted by the condition of the industry.

THE "self-interest" plan used by the San Joaquin Light & Power Corporation of Fresno, Cal., to promote sales of stock to customers is being explained in detail to eastern electrical bodies by A. Emory Wishon.

WATER power saved more than 22,000,000 tons of coal in 1919, according to the returns received from about 2,800 power plants by the Geological Survey.

SEARCHLIGHT developments during the war were described at the meeting of the New York Section of the Illuminating Engineering Society.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

High Cost of Money Forces Illinois Utilities to Abandon Plans

PUBLIC utilities in Illinois, it was announced this week by James H. Wilkerson, a member of the Illinois Public Utilities Commission, will be forced this year to abandon plans for improvements involving expenditures amounting to more than $100,000,000 unless loans can be obtained at more reasonable interest rates. The Chicago Telephone Company, it is reported, has announced that it will not proceed with a request for authorization of a $10,000,000 loan at 7 per cent. It was explained that 9 per cent is asked and that this is considered prohibitive.

State-Wide Interconnection in California by May 1

A TOTAL of ninety-two steam and hydro-electric plants in California, virtually all of the power companies in the state, are to be connected for the first time in one system by May 1, according to a statement recently made by L. S. Ready, assistant chief engineer of the State Railroad Commission.

The daily load of this interconnected system, it is estimated, will be around 10,000,000 kw.-hr. The output of the interconnected plants in 1919 was 3,200,000,000 kw.-hr.

There is only a short job now waiting to be spanned. This is from Newman to the vicinity of Modesto, and when this link is built it will connect the San Joaquin Light & Power Corporation and the Pacific Gas & Electric Company.

Referendum to Business Men on Proposed Public Works Department

AS A result of a petition from Engineering Council, the Chamber of Commerce of the United States has ordered a referendum on the question of creating a national department of public works. This action followed the submission of a special report of a committee appointed by the chamber to study the whole question of public work. Of this committee Charles Nagle of St. Louis, formerly Secretary of Commerce and Labor, was chairman.

The proposal submitted by the Chamber of Commerce to the commercial organizations of the country is "that a Federal Department of Public Works should be created (1) in which can be assembled certain or all of the government agencies with primary functions in the construction or operation of works of an engineering or construction character; (2) which, if found desirable, can take over engineering and construction work now being performed by services with primary functions other than the performance of such work, and (3) which, if found desirable, may act as a contracting agency for the performance of engineering or construction work when called upon by an agency of the government not included in the Department of Public Works."

Approval of the principle underlying the creation of a Federal Department of Public Works consolidating the now widly scattered federal engineering and construction activities has been given by the Merchants' Association of New York. The special committee of which J. G. White, president of J. G. White & Company, Inc., was chairman, while recommending the association's approval, stated that it was of the opinion that an actual plan for consolidation of the engineering and Construction activities of the government should be drafted only after a committee of Congress has made a very careful study of the functions of the bureaus which it is proposed to transfer and assured itself that such a transfer is desirable and will result in increased administrative efficiency.

Electrical Industry Weathering "Outlaw" Strike Excellently

INDUSTRY generally has been upset by the "rump" railroad strike which has swept over the country in the past two weeks, and in a measure the electrical industry has shared in the attending troubles. Where utilities have depended on rail for coal shipments shortages have appeared. In some cases power supply was sharply curtailed to insure a continuance of the lighting supply.

Manufacturers, for the most part, have been plentifully supplied with raw materials. Stocks of finished apparatus, however, are piling up rapidly at the factories, and unless some out-going transportation can be secured shutdowns will occur for want of space to store finished material.

Jobbers' stocks, already in so many instances at vanishing point, naturally are getting poorer and poorer, and even should the strike end this week no large measure of relief can reasonably be expected.

Central stations in the eastern states were for the most part well prepared with coal reserves to meet the conditions brought about by the strike. Embargoes upon all freight excepting necessary foodstuffs have stopped coal shipments. However, the coal reserves of the power companies have thus far been sufficient to enable them to continue operation at full capacity, and they do not expect to find it necessary to restrict the amount of power used by customers. Companies in and about New York City are purchasers of tidewater coal, the supply of which is dependent on rail shipments. On April 15 these companies had on hand coal reserves sufficient for their full requirements for a period of from ten days to two weeks. Should the condition continue beyond this time it will be necessary for these companies to establish a priority list of power users and apportion the amount of power available for each.

At the office of the Public Service Company of New Jersey it was stated that the load on its system had increased materially on account of the use of the trolleys by commuters whose customary trains had been annulled because of the strike.

Manufacturing plants which use central-station energy have shown no falling off in the amount of power required. Among the central-station managers, however, it is the consensus of opinion that should the strike continue for an extended period the inability of manufacturing plants to replenish their supplies of raw materials or ship their finished products away from factories would necessitate shortening the hours of operation and automatically lessen their power requirements.

The Westinghouse Electric & Manufacturing Company has plenty of raw materials for some weeks to come, it was stated in New York on Thursday. Finished material is piling up at East Pittsburgh, but it will be several weeks before warehouse space will be filled up to capacity. The company is working on its heavy bookings.

At the offices of the General Electric Company it was stated that certain raw material stocks are already low and will give out in spots in ten days to two weeks. In general, however, it was stated, the factory can run along for several weeks. Good storage space is still available.

The Westinghouse Lamp Company is shipping from Milwaukee to Chicago by boat and by motor truck from Newark, N. J., to Philadelphia. There are no factory stocks to speak of, and raw materials, except perhaps packing materials, are in good shape.

The Independent Lamp & Wire Company had only sufficient stocks to last a few more days.

Continued operation of New England industry will be seriously threatened by the railroad strike unless it is ended within a fortnight. Many electrical manufacturing plants have but two or three weeks' supply of raw material, and interruption of particular lines of production is liable at any time. Inability to ship products is causing great embarrassment. Connecticut jobbers are hard hit by freight embargoes. Boston jobbers are getting sockets from Connecticut, but steel shipments are throttled and the inflow of washing machines made outside New England has ceased. Sockets are being shipped in carload lots from Connecticut to Chicago stock. Schedule material factories are suffering from the holdup of porcelain shipments from New Jersey. These factories can probably run a month on restricted production. Lamp shipments into Boston are restricted. Brass mills are working full time, but labor trouble threatens the Waterbury district this week. The Lynn Works of the General Electric Company are choked with unshipped motors and other products, but radical curtailment is unlikely, at least for three weeks. Industrial plants in Rhode Island and central Massachusetts can run two to three weeks more, according to the best estimates. The Holtzer-Cabot plant in Boston is inconvenienced by the embargo on outgoing shipments, and the same is true with the Sturtevant plant. Motor truck service has begun from New York to Boston jobbing interests. Central stations are not yet curtailing the output. The Boston Edison company has about one month's coal supply. The Worcester Electric Light Company has had forty-five cars of coal commandeered by railroads during the week and has but two weeks' supply. The situation therefore causes anxiety. Hartford has three to four weeks' supply of coal, Providence four weeks, Springfield two weeks, but the Hydro-Electric supply of 12,000 kw. at Springfield through the Turners Falls interconnection and 20,000 kw. from the Stevenson plant are a great help at Springfield and Waterbury respectively. The Boston elevated railway has ten days' coal supply and ten more on water route. Maine and New Hampshire utilities are functioning well on water power.

Country dealers and buyers of electrical supplies and apparatus in the Middle West have been hit the hardest by the railroad strike. Jobbers and dealers in their vicinity have been somewhat inconvenienced, but so far the electrical manufacturers have not suffered so much from lack of raw material as their customers have from their inability to get the finished products. The combination of the railroad strike and the effective tie-up of express by the express company employees has put a premium on every means of transportation. The rush to the parcel post has so clogged the mails that even first-class mail is being seriously delayed in consequence. Jobbers and manufacturers are delivering around their cities in trucks which would be used for greater distances were it not for the fact that the great demand for trucks has made it impossible to get the necessary equipment.

The Detroit Edison Company shut off power on Monday to all except "essential" industries. It was also reported that Detroit went back to war-time lightless nights. The Mayor of Toledo, Ohio, on Monday ordered the confiscation of coal on the Pennsylvania Railroad tracks and its diversion to the Toledo Railways & Light Company. The Columbus (Ohio) Railway Power & Light Company reported on Tuesday only enough coal to last until this Saturday.

State Power Administrator Now Controls California Output

WITH only one exception the power companies of California, about ninety in all, have signed an agreement whereby the State Railroad Commission is to frame rules for the distribution of electrical energy. Among other things the commission will regulate rates for interchange of energy. H. G. Butler has been appointed state power administrator by the commission to direct all electric power distribution in California.

Mr. Butler, at a meeting of the power companies before the commission, said that as compared with the 1919 demand, the power shortage amounts to 114,000,000 kw.-hr., or 10 per cent. It represents 14 to 18 per cent of the demands this year. This was true of companies in the northern and central parts of the State. San Diego and vicinity would have their normal output of power, owing partly to steam generation, partly to power which could be obtained from other concerns. Los Angeles had an agreement with the Southern California Edison Company whereby the latter agreed to give the city any surplus power it might have, for the privilege of being permitted to distribute as it saw fit any surplus generated by the city.

The estimated demand is from 5 to 9 per cent greater than for the corresponding months of last year. Steam plants, Mr. Butler said, must generate 77,000,000 kw.-hr. per month this year.

The best previous record for the same plants was 64,000,000 kw.-hr. made in August last year.

Actual work being done on California power plants to be finished by the spring of 1921 will add 198,000 kw. generating capacity.

Edison Medal Presentation to W. L. R. Emmet in May

ANNOUNCEMENT of the election of officers of the American Institute of Electrical Engineers will be made at the annual business meeting to be held at the Engineering Societies Building, New York, May 21. Balloting is now going on by mail. At the same time the board of directors will present its report covering the activities of the year.

At this meeting the presentation of the Edison medal to W. L. R. Emmet of Schenectady will take place. The medal was awarded to Mr. Emmet last December.

Presidents of the Four Big Engineering Bodies Will Speak at Chicago

THE presidents of the four great national engineering societies—civil, electrical, mechanical and mining—are announced to address the joint engineering societies of Chicago at a dinner in the La Salle Hotel to be held on Monday evening next, April 19. This meeting has been arranged by the Chicago engineers with the avowed idea of "establishing jointly with the national bodies simple and comprehensive relations for the upbuilding of the profession and for the good of the country." In addition to the speakers mentioned Dr. Lynn H. Hough, president of Northwestern University, Chicago, will deliver an address entitled "Efficient Democracy." A. Stewart Baldwin, past-president of the Western Society of Engineers, will preside.

New York Defeats Proposition for State to Develop Water Power

THE New York State Senate's action on Tuesday in defeating the hydro-electric bill is taken in some quarters as indicating the feeling of the public with respect to government on municipal ownership.

The bill, among other things, provided for the development of water powers by the State of New York and for their later sale to municipalities. The provisions, generally speaking, were similar to those of the laws governing the Hydro-Electric Commission of Ontario, Canada.

Chicago Voters Defeat $15,000,000 Lighting Bond Issue

A BOND issue for $15,000,000 to extend the electric street-lighting system of Chicago was one of four proposed bond issues which the voters of that city refused to approve at the election this week. The public affairs committee of the Western Society of Engineers had recommended their rejection. In making this recommendation to the public the engineers pointed out that the Chicago municipal bond situation was such that it would be impossible to dispose of the proposed issues, totaling $34,500,000, until the retirement of some of the outstanding bonds. There was also said to be no urgent necessity for the work upon which the money was to be spent.

Shipping Board to Develop Electric Drive

BECAUSE of their demonstrated efficiency, electric drive and the Diesel engine will be developed by the Shipping Board, Admiral William S. Benson, chairman of the board, announced at the ninth annual dinner of the National Marine League in New York on Tuesday night.

In order to meet foreign merchant marine competition, Admiral Benson declared, we must make our own motive power the most efficient. He pointed out that electric drive had been demonstrated in the navy to be more economical than the old turbine engine. It was also stated that under no circumstances should American shipowners be persuaded to give up oil for fuel.

"I propose," the Admiral stated almost in conclusion, "to see that the electric drive and the Diesel engine are developed by the Shipping Board."

A Proposed Canadian Institute of Research

A CONSIDERABLE amount of committee work has been done lately in some industrial centers in Canada in favor of a national research institute. A parliamentary committee is strongly in favor of such an institute, and the response from various societies has been quite encouraging. In a forceful circular the committee for national research says:

"As a result of Canada's participation in the great war we are in a serious financial condition. Before the expenses of the war are ended we shall have a national debt of two billions of dollars, the interest alone on which will be $100,000,000. We shall have to meet an annual bill of $30,000,000 to $40,000,000 for pensions. Altogether the annual budget of Canada for many years to come will reach a total of about $450,000,000 which is more than double what it was in the years before the war.

"To carry this burden—a tremendous one for a nation of 9,000,000 people—there will first have to be practiced everywhere and by everybody the greatest thrift and conservation possible, for we are to-day one of the most wasteful of nations; second, there will have to be greater development of all our natural, industrial, commercial, agricultural and, above all, human resources, so that we shall be able to cope successfully with the fierce competition for a share of the world's markets of all kinds that we are sure to meet from all other commercial nations.

"In order to secure this development and be able to meet other nations on anything like an equal footing, it will be absolutely necessary for us to devise new ways and means, through the work of men specially qualified to do research work in all the lines mentioned above. We must never forget that it is largely on the amount of research work done that our strongest competitors are depending for success.

"There is now before the Parliament of Canada the question of establishing a national research institute, which will no doubt develop greatly in a very few years, if only a start can be made now. It is very desirable that all organizations that have the welfare of the country at heart should support this measure in every way possible."

Water Power in 1919 Saved More Than 22,000,000 Tons of Coal

AN AVERAGE daily production of energy of 124,300,000 kw.-hr., of which 33 per cent was produced by water power, is the figure for January as compiled by the Geological Survey from returns received from about 2,800 power plants of 100-kw. capacity or more engaged in public service, including central stations, electric railways and certain others. The capacity of the reporting plants is about 90 per cent of the total.

The Geological Survey's output figures for 1919 were 40,300,000,000 kw.-hr., of which 36.6 per cent was by water power and 63.4 per cent by fuel.

The fuel consumption for 1919 was as follows, the Survey states: 35,000,000 short tons of coal, 11,050,000 barrels of oil and 21,700,000,000 cu.ft. of gas. Converting the oil and gas to coal, an average of 3 lb. of coal was required per kilowatt-hour. On this basis the water powers permitted the saving of 22,140,000 tons of coal in 1919.

It was estimated by the Survey that electric public utility plants consumed about 7.6 per cent of the 1919 production of bituminous coal.

Self-Interest Plan of California Being Told in the East

DURING the past ten days A. Emory Wishon, president of the Pacific Coast Section, N. E. L. A., and assistant general manager of the San Joaquin Light & Power Corporation, Fresno, Cal., has been in the East telling his "self-interest" story. Mr. Wishon has a program which includes talks in New York before the Rotary Club, bankers and manufacturers both in and without the electrical industry, in Pittsburgh, Schenectady, Victor, N. Y.; Pittsfield, Mass., and St. Louis, where arrangements have been made for him to address the St. Louis Electrical Board of Trade and also the St. Louis Chamber of Commerce.

The California electric light and power industry, Mr. Wishon states, is growing so rapidly and the demand is so insistent that $500,000,000 new capital will be needed and spent in the next decade.

To finance this growing demand in a measure the San Joaquin company is selling 7 per cent preferred stock to customers. Instead of selling the stock solely on its financial strength, the "self-interest" appeal is used.

About 25 per cent of the capital required is in this preferred stock and is being marketed in the San Joaquin Valley. The remaining 75 per cent is in the form of bonds and marketed through the usual financial channels. In the first month $500,000 of this preferred stock was sold locally on this basis.

These customers, almost all of whom need additional power, are shown that power cannot be forthcoming until additional capital is in hand. Thus the customers, Mr. Wishon points out, are back of the company.

In addition, the "self-interest" idea reaches out to all of those who are interested in supplying equipment for this development. Mr. Wishon has had charts prepared showing what proportion of every dollar spent in new work is for, each kind of equipment and material and for the labor charge thereon. He is thus able to show what the total expenditure of $500,000,000 means in dollars and cents to each of a number of separate interests. Mr. Wishon is also interesting Eastern capital in the San Joaquin project in the same manner.

Secretary of Bituminous Coal Commission Attacks High Prices

HOLDING that the existing high prices of bituminous coal are inexcusable on any theory of supply and demand or on any other economic theory, Herbert N. Shenton, secretary of the United States Bituminous Coal Commission, which adjudicated the dispute between the soft-coal operators and miners, declared the other day that the advice of the commission to buy and store coal early, the requirements of the export trade, the status of car service, the daily output of the mines, the weather conditions and the supposed shortage of supply all alike fail to explain in any manner the rise in prices, which, he says, is out of all relation to the increase in the cost of production caused by the higher wages granted by the commission.

Mr. Shenton attributed the increase in price largely to the alarm caused by a widespread feeling that there is going to be a scarcity of coal for domestic consumption owing to the foreign demand, but he estimated that exports overseas in 1920 cannot exceed 10,000,000 tons, which is only 2 per cent of total production. There seems also, he says, to be a misapprehension in regard to production. The weekly reports of the Geological Survey, however, show that in the first quarter of the present year production was decidedly in excess of the production last year and slightly in excess of the production under high pressure in 1918. Nor is the fear of immediate suffering from car shortage based on facts. There will be no shortage save as a part of the general transportation difficulties of the present time.

"Frenzied bidding up of prices on the part of coal buyers seems, therefore," Mr. Shenton concludes, "at this time to be entirely unjustified. Efforts are being made to stabilize prices through regulations of the Interstate Commerce Commission and by special legislation. The educational campaign for early buying and storage will also tend to stabilize the market."

New York Illuminating Engineers Hear War History of Searchlights

REVOLUTION in design of army field searchlights during the war was the outstanding feature of a paper read by Doraf W. Blakeslee, former first lieutenant 56th Engineers, in a meeting on April 8 of the New York Section of the Illuminating Engineering Society. Mr. Blakeslee described the experiences in the field which led to the change from the old horse-drawn outfit of 1916 to the light truck-mounted equipment of 1918. Among those discussing the paper were P. R. Bassett and A. F. Dickerson, Schenectady, the latter stating that within ten days after Major Lewis had returned from France with ideas on proper searchlight design derived from battle experience the lamps were being made.

In a historical sketch of street lighting P. S. Millar reviewed the means of illumination from the firebrand through the present electrical systems. In addition to Mr. Millar's slides illustrating the talk, other slides showing the development in New York City were shown by William T. Dempsey.

M. O. Layton, chairman of the Public Works Department Association, made a short plea for the support of engineers in the movement by his association to consolidate all bodies doing public work in order to increase efficiency of management and production.

Further Daylight-Saving Clarification in the East

Daylight saving in New Jersey was defeated on Monday by the State Senate. The measure had previously passed in the House.

Massachusetts has enacted a daylight-saving law, effective April 25. Rhode Island is in the throes of a conflict over the issue, and various Maine cities are proceeding along the line of "local option."

Denver & Rio Grande Electrification Plans Revived

WITH the return of the lines of the Denver & Rio Grande Railroad to private ownership the plans for the electrification of certain parts of the line are being revived. Tennessee Pass, the highest point on the system, and Soldier Summit are the two sections first to be electrified. On the western slope of the Tennessee Pass the grade has an average of 3 per cent up to an elevation of 10,239 ft. (3,070 m.), extending from Minturn to the summit, a distance of 22 miles (35 km.). On the eastern slope the average grade is 1.42 per cent. It is proposed to electrify the western approach and the first few miles of the eastern slope nearest the summit. On Soldier Summit, which is at an altitude of 7,454 ft. (2,236 m.), the grade has been reduced by reconstruction from 4 to 2 per cent with the same grade on the eastern slope. About 12 miles (19 km.) of electrification is proposed there. Plans for the construction of three electrified tunnels under the continental divide are being made. These plans are being made largely on account of the success of the recent electrification work by the Chicago, Milwaukee & St. Paul Railway.

International Electrotechnicians Indorse U. S. Temperature-Limit Scheme

(*Special to* ELECTRICAL WORLD)

EXCELLENT progress was made by the International Electrotechnical Commission's advisory committees on rating, nomenclature, symbols and standard pressures at their meetings which took place at Brussels, Belgium, on March 27 to 31, inclusive. A wireless dispatch to the ELECTRICAL WORLD from Brussels states that a revision of the commission's publication No. 27 was completed and will be issued at once. A large number of graphical symbols were agreed upon. The work of nomenclature, which had been suspended for the past six years, was again started. A special committee of eight nations, including the United States, was formed to draw up without delay a comprehensive vocabulary of essential electrical terms in French and English. It will hold meetings in Zurich in June. Standard pressures for lines and insulator tests were discussed and recommendations prepared.

On ratings a number of important points were agreed upon. The American delegates presented their logical scheme for fixing temperature limits, which was received with great interest and adopted unanimously.

The delegates were welcomed by Prof. Omer de Bast of the Institute Montefiore on behalf of the Belgian committee. He referred in feeling terms to the late Prof. Eric Gerard, who had presided at a similar meeting in 1910 in the same building.

There were about thirty-eight delegates from ten countries present, including a number who attended the first meeting of the commission in 1906. The American delegation included Dr. C. O. Mailloux, president of the commission, and A. H. Moore, H. M. Hobart, C. E. Skinner, L. W. Chubb and Dr. P. S. Agnew. On Saturday, the twenty-seventh, the delegates were entertained at lunch by the Belgian committee, and on Sunday the delegates were taken over the Flanders battlefields by Capt. Leon Gerard, who pointed out the most interesting features of these historic fields. Practically the whole of the devastated area, including Ypres and Dixmude, was visited.

Admirable arrangements were made by Secretary Uytborck. The working sessions were held from early morning until late at night. The delegates gave a luncheon to the Belgian committee and endeavored to express for themselves and their national committees appreciation of the cordial welcome offered by the Belgians and recognition of the great progress made in the face of enormous difficulties in the process of reconstructing their industries.

Electric Furnace Practice Is Topic at Boston Convention

ELECTRICAL progress in metallurgy was exhaustively discussed at Boston last week at the annual convention of the American Electrochemical Society, held jointly with the American Institute of Electrical Engineers and the Electric Furnace Association. About 350 members and guests attended. Chemical technique and electrical engineering practice were allied in joint session on the ninth, when twenty-three papers devoted to problems of mutual interest were discussed. In all fifty papers were presented at the meetings, which were held at the Copley-Plaza Hotel, Boston, and at the Massachusetts Institute of Technology and Harvard University in Cambridge. Trips through the Lynn Works of the General Electric Company, the laboratory of Arthur D. Little, Inc., at Cambridge, the plant of the Huff Electrostatic Separator Company at Arlington and other local establishments were much enjoyed, together with an informal dinner on Friday evening and a social program for ladies accompanying the delegates.

EXPANSION IN ELECTRIC FURNACE USE EXPECTED

The development of electric furnace application was the chief topic of engineering interest. At the sessions on Friday it was generally acknowledged that the electric furnace, when properly designed and handled, through its superior control characteristics has attained an impregnable position in modern industry, and it was brought out that enormous expansion in its use is to be expected. The training of furnace operators, however, is at present very inadequate, and in order also that electric furnace practice may realize the best results closer co-ordination with the central station is of great importance.

An entire session was devoted to thirteen papers on electrically produced alloys, emphasis being laid upon the manufacture of ferro-vanadium, nickel-chromium, ferro-manganese, high-speed steel and other products. B. D. Saklatwalla, general superintendent Vanadium Corporation of America, Bridgeville, Pa., in an exhaustive paper on "The Development of Ferro-Vanadium Metallurgy," predicted that the bulk of the future com-

mercial output will be produced electrically with carbon as the reducing agent.

In the manufacture of ferro-alloys, according to C. B. Gibson, Westinghouse company, 7,500 kw. is now the limiting size of a 60-cycle furnace and about 16,000 kw. on 25 cycles. Automatic regulation is increasing on account of labor and time saving, the more efficient use of power and better control of process. This permits higher speeds of electrode travel, eliminates over-travel, avoids arcing at contacts and prevents feeding of electrodes into the molten bath. Transformers feeding furnaces of 3,750 kw. upward require braced windings to withstand surges and short-circuit currents. Ventilation also needs special attention. The possibility of the blast furnace again competing with the electric furnace in the treatment of ferro-silicon was mentioned.

Data on Energy Consumption

Data upon energy consumption were presented. R. M. Major, Driver-Harris Wire Company, Harrison, N. J., read a paper giving a range of 700 kw.-hr. to 750 kw.-hr. per ton of manufactured product for alloys of the nickel-chromium variety, the furnaces being of moderate size and operated intermittently. Only twenty-five heats are obtained from the roof. Other speakers quoted as low as 200 kw.-hr. to 400 kw.-hr. per ton in brass melting. Various authorities give figures expressed in kilowatt-days for certain ferro-alloys—for example ferro-silicon (10-95 per cent), 109 to 1,000 kw.-days; ferro-manganese (18-75 per cent), 67 to 167 kw.-days; ferro-tungsten, 286 to 400 kw.-days; silicon-manganese, 133 to 333 kw.-days, and ferro-chromium, 286 to 555 kw.-days. Furnace manufacturers maintain that in many cases energy consumption is of far less importance than product quality, but furnace users strongly urged keeping down both demand and energy input in view of their great influence upon central-station rates. The manufacture of cobalt-chromium alloys in the electric furnace was described in a paper by Elwood Haynes, Kokomo, Ind., who pointed out that from 2,000 to 3,000 melts are obtained by using a magnesite lining. R. C. McKenna, Latrobe, Pa., pointed out that the average power consumption of a 3-ton heat of high-speed steel melt is 1,000 kw.-hr., the average life of lining and roof in the Heroult type furnace used being eighty heats. The bottom of specially prepared dolomite lasts for about 500 heats. Various speakers agreed that by the use of the electric furnace a more uniform product in tool steel is procured than is possible by any other method. M. A. Hunter and J. W. Bacon, Rensselaer Polytechnic Institute, submitted a comprehensive paper upon the electrical properties of titanium alloys, which showed that the addition of titanium to iron improves the magnetic qualities of the latter.

Viewpoints on the Power Problem

Eleven papers bearing upon the power problems of the electric furnace were presented in a symposium representing furnace manufacturers, operators and central stations. The Electric Furnace Association held a conference during the conventions at which the vital importance of better training of furnace operators was discussed, and the opinion was generally expressed that manufacturers and users should co-operate toward this end. Such training is essential in cutting down peaks as well as in insuring higher grade production. In the symposium above mentioned the importance of continuous, reliable service on the part of the central station was emphasized, while the necessity of reducing peak loads was firmly set forth by the electric utility representatives.

H. L. Hess, Baltimore, Md., and W. G. Berlin, High Bridge, N. J., each presented a paper upon power problems from the furnace operator's viewpoint. Both authors criticised central-station rate schedules as unduly complex, but in the discussion there appeared to be general recognition of the fairness of a demand charge and an energy charge. The point was made that the protection of small central stations by public utility commissions has sometimes worked injustice to furnace users who might better be supplied from nearby utilities with greater power resources. Had this been possible, in a typical case the power cost per ton of metal could have been cut down 50 per cent. Parallel operation, it appeared, worked out better for the furnace operator than for the central station. Various speakers showed that much might be done in future to improve operating conditions by the joint efforts of furnace users and central-station representatives through conference regarding the hours of service, off-peak rates, selection of reactors, design of appropriate feeder systems, scheduling of runs for night periods and clear explanations of methods of billing for energy. E. A. Wilcox, Pittsburgh Electric Furnace Company, presented a comprehensive paper upon furnace power requirements from the central-station viewpoint, and A. C. Smith, Buffalo General Electric Company, read a trenchant paper in which the importance of cutting down surges was discussed specifically. Feeding by separate lines from substations carefully laid out with respect to industrial load development, as on the Detroit Edison system, was favored in the discussion.

Discussion of Furnace Operating Data

The need of more data upon the behavior and life of electrodes in the rocking type of furnace was emphasized. F. W. Brooke, Philadelphia, and E. L. Crosby, Detroit, defended the furnace manufacturers from charges of overenthusiasm in regard to operating data, in response to a general criticism of Lewis B. Lindemuth, New York City, who submitted a searching paper on the position of the electric furnace in iron and steel metallurgy. The last-named contributor declared that steel made in the electric furnace by the basic process is superior to that produced by the acid process in the electric furnace. A marked tendency toward the use of larger furnaces and toward forced heating is apparent. Divergent views were evident regarding the extent to which power factor is involved in furnace service. In general, power factors from 65 to 90 per cent were held to be satisfactory, varying with local conditions. Prof. J. W. Richards presented a paper describing the Söderberg self-baking continuous electrode, with data upon its successful use at Fiskaa, Norway. Other papers of electrical engineering interst were: "The Evolution of the Electric Brass Furnace," by H. M. St. John, Detroit Electric Furnace Company; "Step Induction Regulator for Electric Furnaces," by P. B. Short, Westinghouse company; "Fundamental Problems in Alloys Research," by H. E. Howe; "Nitrogen Fixation by the Silent Discharge Process," by Prof. C. F. Harding; "Magnetic and Electric Properties of Iron-Nickel Alloys" (see ELECTRICAL WORLD, April 3, 1920, p. 774), by T. D. Yensen; "Reactors for Electric Furnace Circuits," by

H. A. Winne, General Electric Company; "Economics of the Power Situation," by C. A. Winder, General Electric Company; "Power for Electrochemical Purposes," by John L. Harper, Niagara Falls Power Company; "Water Powers of the Pacific Coast," by F. F. Fowler; "Location for New England Electrochemical Plant," by C. T. Maynard, Rumford Falls (Me.) Power Company, and "Power Development in Scandinavia," by J. W. Beckman.

ELECTION OF OFFICERS

Officers were elected as follows for the American Electrochemical Association: President, W. S. Landis, New York; vice-presidents, John A. Mathews of Syracuse, N. Y., L. E. Saunders of Worcester, Mass., and A. T. Hinckley of Niagara Falls, N. Y. Managers elected were C. G. Fink of New York, Acheson Smith of Niagara Falls, N. Y., and H. B. Coho of New York. P. G. Salmon, Philadelphia, was elected treasurer, and Dr. J. W. Richards of Bethlehem, Pa., secretary.

For the Electric Furnace Association these officers were elected: President, Acheson Smith; vice-presidents, H. L. Hess of Baltimore, Md. and C. H. Booth of Chicago; secretary, C. G. Schluederberg of Pittsburgh; treasurer, F. J. Ryan of Philadelphia; directors, H. G. Weidenthal of Cleveland and F. J. Tone of Niagara Falls, N. Y.

Extracts from various papers presented at the above conventions will be presented topically in later issues.

Easier to Contract for Power Than to Finance Development

BECAUSE of a situation in relation to earnings that would make it difficult to finance necessary extensions, the Consolidated Light, Heat & Power Company of Huntington, W. Va., has entered into a contract with the Virginia Power Company of Charleston, W. Va., whereby commercial power sufficient for existing and prospective industries in Huntington is assured for a period of ten years. This contract, as explained by General Manager W. R. Power of the Consolidated company, provides for delivery of power to the city limits of Huntington by the Virginian Power Company, which will run high-tension wires from its plant at Cabin Creek to some point immediately east or south of Huntington. A minimum of 3,000 kw. and a maximum of 5,000 kw. is called for, but the contract further provides for the extension of the maximum to 15,000 kw. when the need shall arise. The contract is to become effective Dec. 1.

To fulfill this contract the Virginian Power Company must expend approximately $350,000 and the Consolidated Light, Heat & Power Company in the neighborhood of $100,000.

Work on Tugaloo Hydro-Electric Development Resumed

AFTER eighteen months' suspension caused by conditions following the war, work on the Tugaloo hydro-electric development of the Georgia Railway & Power Company, which was begun two years ago, is being resumed. This development is on the Tugaloo River, Georgia, immediately below the junction of the Tallulah and Chattooga Rivers. A power house, 60 ft. x 190 ft. (18 m. x 57 m.) in size, with an installed capacity of about 75,000 hp. in waterwheels, will be built below a masonry dam 150 ft. (45 m.) in height. Four waterwheels rated at 18,750 hp. each will be directly connected to 6,600-volt, three-phase, 60-cycle, 12,500-kw. vertical-type alternators. Two banks of 25,000-kw. transformers, each consisting of three single-phase units, will raise the voltage to 110,000 for transmission over a new line about 3 miles (4.8 km.) in length to the double-circuit 110,000-volt steel-tower line extending from the existing plant at Tallulah Falls to Atlanta, the company's central point of distribution.

The S. Morgan Smith Company of York, Pa., holds the contract for the waterwheels and the General Electric Company that for the generators. The construction work will be done by the Georgia company's own organization. Charles G. Adsit is chief engineer.

Accrued Depreciation Not Allowed Where Rates Were Inadequate

ACCORDING to a decision of the New York Public Service Commission, Second District, in proceedings brought by the Elmira Water, Light & Railroad Company for increased rates, a public utility which in the past has failed to maintain a sufficient depreciation charge to cover renewals and replacements, but has not received an excessive return on the value of its property, should not be compelled to deduct from its rate base an amount equal to the accumulated theoretical accrued depreciation. Extracts from this decision, which was rendered on Jan. 22, have just been printed in pamphlet form by the United Gas & Electric Engineering Corporation of New York, which owns and operates the Elmira property.

If the returns that should have gone into the depreciation reserve have been disbursed in increased dividends, the commission holds that the company should be required to keep the plant up to full efficiency by proper renewals and replacements which will have to be paid for out of moneys which otherwise might go to stockholders. On the other hand, the commission in its decision declares:

"If the company has not made a fair return and the consumers have not been charged in current rates, from year to year, any appreciable amount to meet such accruing depreciation, the present public should not require such a company to make good at once the full amount of such theoretical accrued depreciation by deducting the whole of the theoretical accrued depreciation from the rate base. The public has had the benefit of rates which were lower by the amount of the allowable depreciation ratio which was not included. The public has not paid nor the company received the 'annual depreciation ratio.' The company has not availed itself of the opportunity to build up a reserve. That was a gain to the consumers and was of course reflected in rates.

"The amount of the loss to the company will some day be fixed when renewals and replacements must be made. When that day comes the company will have to meet the loss. However, in the meantime, if the company delivers and the public receives full service, it seems hardly fair to use the ratios of annual depreciation which were meant to estimate the annual sum to be set aside and apply them as a definite measure of actual present loss in value to that amount and deduct the same from the rate base."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Feeding the C., M. & St. P.—Since August of last year the Washington Water Power Company has furnished 8,000,000 kw.-hr. and the Puget Sound Traction, Light & Power Company has furnished 150,000 kw.-hr. to the Chicago, Milwaukee & St. Paul Railway for its mountain lines.

British Wireless Research Board.—The Department of Scientific and Industrial Research of the British government has established a wireless research board, the object of which is to co-ordinate and develop the research into wireless telegraphy and telephony now being undertaken officially. Admiral Sir Henry B. Jackson is chairman of the board.

Japan's High Poles.—What are said to be the highest concrete poles in the world (660 ft.) are being erected at Tomioka-cho, in Fukushima Prefecture, Japan, for the new wireless stations which will be opened early in April especially for communication between Japan and the United States. The capacity each way is about 8,000 words a day.

Music by Wireless.—A demonstration of an invention by Thomas Brass, a sergeant in the United States army, by means of which music can be sent over the wireless telephone, was recently given before the Atlanta (Ga.) Radio Club and is reported to have been entirely successful. A very sensitive diaphragm for a two-step amplifier receiving set was used. Individual head sets were worn by the auditors, but the inventor expects to enable music to be heard clearly without the use of these.

Baltimore Company's Success in Selling Stock to Customers and Employees.—More than 2,000 customers of the Baltimore Gas, Electric Light & Power Company have thus far completed instalment payments under the company's stock purchase plan and have received stock certificates representing a par value exceeding $1,125,000. More than 1,200 employees—40 per cent of the total—are now participating in the company's savings and investment plans. One hundred and ninety-five employees own 6,065 full-paid shares.

Klamath Falls Dam Controversy Near End.—It is authoritatively asserted that the California-Oregon Power Company is ready to relinquish its contract with the United States government for the building of the Link River dam, which includes provisions for the storage and distribution of power and irrigation water supply in the Upper Klamath Lake, on assurance that the government will build the dam at once. The agreement provides a solution for a controversy that has stirred up much factional dispute and resulted in retarding irrigation development.

One Telephone to Ten Persons.—From the Bureau of the Census, Washington, D. C., the report on telephones which forms part of the census of electrical industries for 1917 can now be had. According to this report, there were in that year 11,716,520 telephones in the United States, exclusive of certain railway, government and private lines. The estimated number of messages or talks was nearly 22,000,000,000, the miles of wire reached 28,827,188, the employees numbered 262,629, and the value of plant and equipment was almost $1,500,000,000. Seventy per cent approximately of the telephone business was done by the Bell system.

Using the Airship to Boom the Electric Range.—In a campaign to interest the housewives of Rome, Ga., in electric appliances for home use the Western Electric Company's Atlanta office sent an electric range by aeroplane to the Walker Electric & Plumbing Company of Rome, covering the 70 miles in one hour and twenty-five minutes at a cost

for transportation of $100. The shipment was accompanied by a message extolling electric service written by Mrs. Newton C. Ring of the Atlanta Woman's Club and addressed to the Woman's Club of Rome.

Water Power Development in Oregon.—A permit has been filed with the State Engineer of Oregon to appropriate 100 second-feet from the middle fork of the Malheur River to develop 26,000 kw. This power will be used to pump water for the irrigation of Harney Valley and for municipal purposes in the town of Vale. The project will cost $350,000 and work will start on it before the end of the year.

Giving Publicity to Copper Conditions.—A systematic research into the sources, forms and uses of copper is to be carried out by leading producers and manufacturers of that metal for the enlightenment of the public. An organization with a cash fund of $50,000 has been formed for this purpose, and Ivy Lee of New York will have charge of the publicity work. It is the intention to carry on the investigation in Europe and Asia as well as America, and special inquiry will be made into the extent to which Germany denuded herself of the metal during the war.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Electric Power Club.—The annual convention of the Electric Power Club will be held May 5 to 8, inclusive, at Signal Mountain, Tenn.

Arkansas Utilities Association.—The convention of the Arkansas Utilities Association will be held at the Arlington Hotel, Hot Springs, Ark., on April 26, 27 and 28.

Society of Automotive Engineers.—A meeting of this society to be held in Witherspoon Hall, Philadelphia, on Thursday, April 22, will be addressed by C. F. Kettering.

A. S. M. E., Philadelphia Section.—"Modern Practice in the Manufacture of Steel" will be discussed by Colonel W. P. Barba before this section of the American Society of Mechanical Engineers on Tuesday, April 27.

Tri-State Water and Light Association.—Reports from various sections of North Carolina, South Carolina and Georgia point to a record-breaking convention of this association at the Piedmont Hotel, Atlanta, on May 19 to May 21.

I. E. S., Chicago Section.—This section of the Illuminating Engineering Society will meet at the rooms of the Western Society of Engineers on Wednesday, April 21, to hear M. Luckiesh of the National Lamp Works research laboratory, Cleveland, speak upon "Lighting and the Householder."

Association of Iron and Steel Electrical Engineers.—The next meeting of the Cleveland Section of this association will be held on Saturday, April 24. On May 22 members of the section will join with the Pittsburgh Section in its inspection trip to the works of the Trumbull Steel Company, Warren, Ohio. A similar trip of inspection was made by the Philadelphia Section, A. I. and S. E. E., on Saturday, April 10, when the Lukens steel plant at Coatesville, Pa., was visited.

Electric Club of Louisville.—Since the Electric Club of Louisville, Ky., was organized last November to take the place of the former Louisville Jovian League the entertainment committee has been very successful in introducing new features to maintain interest in the regular meetings on the first and third Mondays of each month. The regular meeting of April 5 was in charge of A. R. Magee, superintendent of foreign advertising for the Louisville *Courier-Journal and Times*. In honor of the event a special four-page miniature edition of that paper was published and christened the *Louisville Electric Club Extra.*

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Working Capital Allowable.—A cash allowance for working capital of an electric utility equivalent to two months' average operating expenses plus stores and supplies on hand was approved by the Public Service Commission of Missouri in a rate-making proceeding, sums due from but retained by an interested company and amounts to cover unbilled energy being eliminated from consideration.

Extension of Service to Rural Lines Without Certificate.—Under a general order of the Illinois Public Utilities Commission covering the construction, ownership and maintenance of electric distribution circuits in rural districts, an electric company is not required to obtain a certificate of convenience and necessity for the extension of service to rural lines owned and maintained by a mutual association for operation without profit.

Intercorporate Relations as Affecting Public Benefit. — The Public Service Commission of Missouri has held that the purchase, subsequent to the filing of a complaint, by a distributing company, defendant in rate proceedings, of the property and assets of its supplying company—thus removing cross-charges for hydro-electric energy—renders ineffectual an allegation that the distributing company serves as a pretext for the diversion of the saving and benefit of hydro-electric energy from the public.

Service and Minimum Charges.—In sustaining increased power rates put into effect by the Pine Grove Electric Light, Heat & Power Company, the Pennsylvania Public Service Commission insists, however, on the elimination of coal and war clauses from the tariff and on the cancellation of a ready-to-serve charge of 50 cents on motors of 1 hp. and less and of 15 per cent of the gross monthly bill on all motors over 1 hp. The commission holds that a charge for service is already substantially included in the minimum charge of $1 a month.

Exploitation of Franchise and Duplication of Service Alike Against Public Interest.—The Glen Mills Electric Company having applied for permission to do business in territory covered by the franchise of the Thornbury Township Electric Company, it was shown that the latter had allowed four years to elapse without making any substantial effort to furnish service until the rival company sought to enter its field. The Public Service Commission of Pennsylvania held that in normal circumstances such inactivity could not be tolerated, certificates not being granted "in order that legal rights may be acquired by corporate interests and then held for the purpose of exploitation or development at a later period." However, in view of war conditions another opportunity was given to the Thornbury Township company and the plea of the Glen Mills company was denied on the ground that "competition in public service, with its attendant evils of duplication of plant investment, the burden of which ultimately falls upon the ratepayers, is of course to be avoided."

Protection from Competition. — The Libbe Power Company, a small concern at Washington, Mo., generates electricity for use in the factory of its proprietor and in addition supplies it to two customers, one of them on the other side of the street. In view of this fact the Union Electric Light & Power Company of St. Louis made complaint to the Public Service Commission of that state to the effect that the company complained against was engaging in the business of generating and selling electricity without having obtained a certificate of convenience and necessity. The commission found that, under a ruling of the Supreme Court of Missouri, such a plant as that of the defendant is not devoted to public use and is not an electrical corporation within the meaning of the law.

"Dumping" Power Is Condemned.—Summer Customers.—An electric company which has developed its plant greatly beyond the needs of its own territory and beyond any reasonably anticipated growth cannot, the Maine Public Utilities Commission declared in adjudicating complaints against the Bar Harbor & Union River Power Company, regard this surplus energy as "dump power" to be disposed of at a low price to a large customer which it controls, so as to cast the burden of carrying such surplus investment upon its regular customers. In the cases under notice the commission applied a principle recognized by it previously and involving the seasonal rate to summer customers of a public uility: That if the summer business creates an increased demand, then the principle of readiness to serve applies, which is that the summer customers must pay their proportional part of the overhead and all-the-year-round charge and expense occasioned by the increased capital invested, depreciation, maintenance, insurance and those charges which go on regardless of the extent of consumption. The commission found, however, that there is lawful justification for a difference in the rates which the company might charge its "seasonal customers" and those it might charge its "year-round" customers and ordered it to amend its schedules and in such amendments so to classify its customers as to show clearly to each customer the class within which it is claimed he comes and the rate at which service is offered.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Power of Judge to Direct Verdict in Case of Contributory Negligence.—In a case where an employee of a mining company was killed by grasping, without looking to see what he was doing, a live blade instead of a switch handle, and where $5,500 in damages was awarded by the trial jury to the father of the victim, the Supreme Court of Arizona has overruled the verdict and ordered the suit dismissed, on the ground that where the facts are undisputed and a clear case of contributory negligence is established it is the duty of the judge to direct the jury to find accordingly. (187 P. 563.)

Contributory Negligence Not Shown in Case Where Electrical Supply Company's Neglect Injured Workman.—An electrician employed in a private residence to repair secondary wires carrying 110 volts was severely injured through the contact of these wires with bare primary wires improperly installed and carrying 2,300 volts. The electric supply company, in appealing to the Supreme Court of North Dakota against a verdict for $15,000 damages, alleged contributory negligence inasmuch as the workman only took the precaution of standing on a dry board when he might have cut off the circuit. The court found that had it not been for the negligence of the company the workman's precaution would have been ample. (176 N.W. 352.)

Discrimination Cannot Be Allowed.—Finding that the Southern Power Company, having a monopoly of hydro-electric power supply and the markets therefor in the territory through which its lines extend, was seeking to charge the Salisbury & Spencer Railway Company 1.8 cents per kilowatt-hour for energy while charging, under similar conditions, only 1.1 cents to other corporations, with which in some cases the supply company had close relations, the Supreme Court of North Carolina sustained the lower court in overruling a demurrer filed against a writ of mandamus to compel the Southern Power Company to cease such discrimination. The Supreme Court denied the right of the defendant company to select its customers or to fix its rates according to the peculiar circumstances of each case without regard to the authority of the Corporation Commission. It also held that if a purchaser of energy from such a company as the defendant retailed the power itself at an excessive profit, this fact would not justify discrimination against the purchasing by the selling company. (101 S. E. 593.)

Men of the Industry

Changes in Personnel and Position—Biographical Notes

S. M. Kennedy, formerly general agent of the Southern California Edison Company, Los Angeles, Cal., has been elected vice-president and general agent and will have charge of business development and public relations. Mr. Kennedy became identified with public utility work in the West in 1901, when he accepted the position of assistant to the president of the United Electric Gas & Power Company of Los Angeles. When that company was absorbed by the Southern California Edison Company in 1903 he was made general agent and has since held that position and been largely responsible for the commercial end of the company's business. Mr. Kennedy has always been an active worker in the National Electric Light Association and the Pacific Coast Sections of the N. E. L. A. and A. I. E. E. He is the sole member of the present committee of the N. E. L. A. on public relations and will make a comprehensive report at the national convention at Pasadena in May.

S. M. KENNEDY

A. M. Evans of Chicago, who has been with the local traction companies for the last fourteen years, has resigned his position as assistant to the chief engineer of the Chicago Surface Lines to accept a post under Col. Peter Junkersfeld in the organization of the Geyser Electric Company of Chicago. During the war Mr. Evans served in the construction division of the army in various capacities. He was made executive assistant to officers in charge of the building staff and later gained the rank of major and received a citation from the Secretary of War.

Ake Alin, assistant engineer of the Royal Swedish Waterfalls Board, who has been sent by the Swedish government to examine large dams in the United States, is in San Francisco. Mr. Alin is to examine the Hetch-Hetchy works and other large construction projects on the Pacific Coast. The Swedish government is contemplating the building of large power dams in northern Sweden.

Paul L. Bean, formerly chief engineer Maine Public Utilities Commission, has become associated with Walter L. Sawyer, consulting engineer, Lewiston, Me., specializing in water-power practice.

Lewis G. Webber, formerly assistant electrical engineer with Fay, Spofford & Thorndike, Boston, on the Boston army base installation and previously with Monks & Johnson on the development of electrical equipment at the Squantum (Mass.) destroyer plant, has joined the staff of Roy R. Burnham, consulting engineer, Boston, as principal assistant.

H. W. Young, president of the Delta-Star Electric Company, Chicago, is receiving the sympathy of his friends on the death of his wife, Dorothy S. Young, on March 30. Mrs. Young was not only widely known among members of the industry as a hostess but had also accompanied her husband for years on his extended business trips and added to a charming personality a business ability that had been of no small assistance to him.

Robert M. Searle, vice-president of the Rochester (N. Y.) Railway & Light Company, has been elected president of that company to succeed James T. Hutchings, who has resigned to become assistant general manager of the United Gas Impovement Company of Philadelphia. Mr. Searle went to Rochester fourteen years ago from the organization of the Westchester Lighting Company. He entered the electrical field in 1884 as office boy with Thomas A Edison. In the course of his promotions from that position to his present duties he has passed through the various branches of the central-station business and has served in a number of capacities involving duties of state and national scope.

R. M. SEARLE

Eugene A. Roberts, manager of the Public Utilities Company of Carlsbad, N. M., has recently been elected president of the New Mexico Electrical Association. This association at its annual meeting, as reported in the ELECTRICAL WORLD for Feb. 21, page 451, voted to separate from the Pacific Section, N. E. L. A., and with similar associations of Colorado and Wyoming form the Rocky Mountain geographic section. Mr. Roberts is a graduate of the New Mexico Military Academy, class of 1912, and since that time has been employed by the Public Utilities Company.

E. A. ROBERTS

Herbert C. Stephens, who recently resigned as power engineer for the Northern Ohio Traction & Light Company of Akron, Ohio, has accepted the position of sales engineer for the Electric Motor & Repair Company of that city. Mr. Stephens was graduated from the University of Illinois in 1908.

Dr. Willis Rodney Whitney, director of the research laboratory of the General Electric Company at Schenectady, N. Y., to whom the Chandler medal has been awarded, will receive that recognition of scientific achievement on April 27 at Havemeyer Hall, Columbia University, New York City, when he will make an address on "The Littlest Things of Chemistry."

Samuel Ferguson, vice-president of the Hartford (Conn.) Electric Light Company, has been elected president of the Connecticut Power Company, which was recently acquired by the Hartford company. Mr. Ferguson's work in the field of interconnection is putting central-station service in Connecticut on an advanced plane of economic usefulness, through the co-operation of the Hartford company and other companies supplying energy to the central portion of the state.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Insulation Materials Higher Under Longer Shipments

INSULATING materials are characterized by longer shipments, higher prices and in some cases withdrawn prices. Spot cotton in New York is 43 cents. Prices on cotton webbing, tape, tubing, varnished cambric and friction tape are higher by about 5 per cent since the last of March, and reports from insulation jobbers show they are likely to change overnight. The demand for cotton insulations is heavy, and shipments from the factory are about three months. Finishing mills are hard put to it to get yarns for electrical uses because of the heavy demands on this material from other sources, especially from the automobile trade. In this connection the shortage of long-fiber cotton for cord tires has just caused the curtailing of output of at least two tire mills and is requiring the use of other kinds of cotton in the electrical trade where the long fiber was formerly used. Higher prices at the semi-finishing cloth mills are the result of material shortage and the high labor turnover, which is rather too rapid for economical operation. Prices are so uncertain in the case of one manufacturer that there are no general quotations. Specific prices can be obtained only when there are determined the size of the order, amount of material needed and time of shipment. This is deemed necessary because of uncertainties in production in the semi-finished mills.

Varnished silk cloth and tape is reported 20 per cent higher than it was three weeks ago. Shipments are in general longer than for cotton goods because of a reported greater shortage of the semi-finished product. One producer of silk insulation is still shipping on orders of last June. Insulation varnishes, too, are higher by about 5 per cent.

Canada's Relation to the Electrical Industry

CANADA during the fiscal year 1919 imported electric apparatus to the value of $11,005,753, of which no less than $10,887,657 came from the United States. Imports of American goods of this kind have more than doubled during the last five years. In 1915 they were $5,137,383 and in 1919 they were $10,887,657. Imports of electric supplies from other countries during that year were: Great Britain, $88,778; France, $2,803; Spain, $19,629; Sweden, $6,480. In January of the present year Canada imported $953,361 worth of electric and gas fixtures, of which $930,773 came from the United States. Canada is also becoming quite an exporter of electrical apparatus. In 1915 these exports were valued at $97,870; in 1919 they were valued at $2,167,545.

Though the manufacturing of electrical apparatus is one of the newer of the Canadian industries, it is making satisfactory progress. The report of the Bureau of Statistics for 1918 shows that there were sixty-eight plants in operation throughout the Dominion, forty-two being in Ontario, thirteen in Quebec, seven in Manitoba, three in British Columbia, two in Alberta and one in Saskatchewan. The total capital investment for the Dominion was put at $43,285,405, divided as follows: Land, buildings and fixtures, $10,636,572; machinery and tools, $6,518,138; materials, stock in process, finished products, etc., $17,071,528; working capital, $9,059,173. The total investment is divided among the provinces as follows: Ontario, $26,426,129; Quebec, $16,525,454; Manitoba, $253,026; British Columbia, $42,881; Alberta, $19,736; Saskatchewan, $18,179. The number of employees is given as 8,862, while the salaries and wages paid during the year totaled $8,456,705.

The total selling value of all articles produced at the works in 1918 was $30,045,399, the value of the principal products being: Dynamos, generators and converters, $1,503,433; transformers $2,291,874; switchboards, panels, etc., $990,898; motors, $2,727,673; storage batteries, $213,624; primary batteries, $1,397,635; incandescent lamps, $1,525,198; insulated wires and cables, $5,154,984; other electrical machinery, $1,738,085; carbons, $1,362,666; other miscellaneous products, $8,492,643.

Low Stocks Expected to Melt Away in Transit Tie-Up

HAD this transportation tie-up come in normal times most jobbers undoubtedly would have had sufficient stocks of the essential wiring materials to last for some time. Manufacturers, too, would have been able to keep up production beyond the life of any probable tie-up. But, coming as it has on the heels of a transportation-crippling winter, with manufacturers unable to obtain sufficient raw material to meet the demands of the electrical market and jobbers unable to supply the orders on their books, it has found raw-material stocks and jobbers' stocks at an extremely low level.

There is some flexible armored conductor in the market, but in most cases it is in lots of a couple of thousand feet and is being held for emergencies. Several manufacturers in the East will undoubtedly have to close down production if steel-strip stocks are not replenished by the end of the present week. It is some time since they have had anything close to a stock of strip on hand. One producer says he has been running only intermittently for the last six months. The mills supplying the strip are also having trouble in obtaining their supply of raw material from which to make the strip. It is the policy in at least one quarter not to accept orders for flexible armored conductor under present production conditions as shipments are so uncertain as to be too unsatisfactory.

Rigid conduit production is nearly as bad. Some jobbers have a little of all sizes, maybe a few thousand feet, and some are out of ½ in., ¾ in. and 1 in. The mills have shipped carloads of the pipe, but it is held up in transit. For New York City jobbers in particular there are a number of cars of pipe on the Jersey meadows and in terminals. Where pipe and other materials are in the terminals the jobbers are getting some of it by trucks, where they can find transit across the river. The few ferries running permit of a light flow of materials into the city by way of private trucks. Material arriving at and departing from coast points by boat is, of course, held up.

There has been a great deal of trucking between manufacturers and jobbers in the New England, New York and Philadelphia districts, especially in the movement of schedule material, pipe, steel strip, lamps, wire, flexible armored conductor and boxes. In this way jobbers are keeping some semblance of stocks, but even this small amount will not last very long unless the strike breaks quickly. A canvass of several prominent Eastern jobbers brings to light some cases of virtually no stocks of the general run of wiring materials, with the exception of rubber-covered wire. Of course, at the same time sales can be made only within trucking distance of the source of supplies, so it is expected that the demand will fall off to some extent.

Improvement Shown in Electrical Exports for February

A SLIGHT improvement was made in electrical exports during the month of February, 1920, when the total value of these exports amounted to $6,583,228. This is $235,791 higher than the value of January's exports but nearly a million dollars less than the amount received for electrical goods in February of 1919.

The greatest improvement over January is shown in batteries, fan motors, metal-filament lamps, motors, rheostats and switches, while smaller gains were shown in heating devices, interior wiring supplies, carbon-filament lamps, meters and telephone instruments. Telegraph instruments fell off heavily.

These figures for total exports for the month compare well with those of the three previous months in showing clearly the rather lower level of exports during the period of depressed European exchange. With this in mind the present year is starting out at a rate only about ten million dollars behind the total of the previous year, which was the highest ever recorded.

Following are the figures for February, based on the returns of the Bureau of Foreign and Domestic Commerce:

	February		Two Months Ended February	
	1919	1920	1919	1920
Batteries	$420,437	$526,972	$766,248	$901,702
Carbons	161,117	76,586	350,468	216,226
Dynamos or generators	387,445	363,340	637,298	776,633
Fans	121,003	79,780	297,529	109,367
Heating and cooking apparatus	71,136	140,020	169,651	253,839
Insulated wire and cable	710,830	567,036	1,515,311	1,228,878
Interior wiring supplies	211,402	195,514	405,967	364,403
Arc lamps	2,702	172	2,908	262
Carbon-filament lamps	16,658	9,746	36,699	16,879
Metal-filament lamps	403,379	363,391	581,554	575,088
Magnetos, spark plugs, etc.	256,280	251,876	535,454	513,418
Meters and measuring instruments	255,495	219,454	579,899	407,587
Motors	1,107,268	825,727	1,788,150	1,559,549
Rheostats and controllers	16,442	86,482	64,878	105,040
Switches and accessories	189,669	381,203	366,828	675,239
Telegraph apparatus	129,596	16,750	186,137	200,154
Telephones	333,180	253,457	547,352	483,643
Transformers	401,594	295,185	710,622	645,549
All others	2,370,456	1,930,537	4,345,660	3,897,209
Total	$7,566,089	$6,583,228	$14,288,613	$12,930,665

Concentrated Production Expected to Improve Service

THE Simplex Electric Heating Company, Cambridge, Mass., has recently inaugurated the policy, which will undoubtedly be watched with much interest by other manufacturers, of concentrating manufacturing effort upon a much less diversified line of products than has formerly been listed in the output of this house. The management felt that better service could be given to the trade by confining factory work to certain main lines of output which might be called staple goods, and that greater opportunities for profitable manufacture accompanied this policy than were possible under the old plan, which was characterized by great variety of designs, types, sizes and styles. During the past winter the total number of product variations has been reduced from 617 to 44.

The output of the factory is now grouped around the following so-called "leaders": Flatirons, ranges, heating pads, toasters, radiators and soldering irons, under which headings there are various types. The items dropped from future production include glue pots, pitch kettles, immersion coils, corset soldering irons and a long line of specialized heating apparatus which the company does not care to undertake to build under present conditions, unless in some particular case arrangements should be made for extremely large orders running up into totals that would pay the manufacturer for inaugurating virtually a new line for the time being.

The foregoing simplification of output has already put the company in an unusually good position to handle orders for spare parts, and maintenance work can be done much more quickly than formerly. The freight embargoes in New England resulting from severe winter weather have held back the arrival of much material, but with the opening of spring delivery conditions begin to show decided improvement. The reduction in the company's line, it is felt, will give better control of overhead costs, permit the maintenance of better factory stocks in extra parts, facilitate catching up on orders, reduce unit production expense in due course (barring unforeseen changes) and enable the company's business to be developed symmetrically and intensively for the joint benefit of its customers and itself. Factory space formerly assigned to diversified output is being co-ordinated for larger production within the stated range, and as conditions require and the market and resources of the company justify it new lines can be brought out to yield to the consumer the benefits of advances in the art of electric heating.

European Market for American Electrical Goods

AS THE result of a visit last summer to Europe in connection with an investigation into the market there for electric meters and similar devices Robert C. Lanphier, general manager of the Sangamo Electric Company, has made some observations on the conditions found in France, Spain, Italy, Switzerland, Belgium, Holland, the Scandinavian countries, and especially in England and Scotland.

"Throughout the war Denmark, Holland and especially Sweden were in communication with Germany," said Mr. Lanphier, "and it was amazing to learn of the large quantity of electrical apparatus supplied to these countries by Germany even when the war was at its height. For example, I was told in Holland that one or two of the largest German electrical manufacturers supplied the Electricity Works at The Hague with about 15,000 meters in 1917, and even during the great German drive in the spring of 1918 meters and other apparatus were being shipped in quantities to Holland. I saw some of the product thus made in Germany under war conditions, and while substitutions had to be made in many cases, such as pewter and zinc castings where brass would ordinarily be employed, paper insulation in place of mica or composition, etc., yet the product was really creditable considering the conditions under which it had to be made. I state this, not from the standpoint of any particular credit due the German manufacturers, but to emphasize that we should not underestimate the difficulties we must face in competition with the German electrical manufacturers, now that they no longer have to contend with war conditions.

"In Great Britain, France, Italy and Belgium there was still a strong feeling against the purchase of German goods, although by the middle of 1919 this was beginning to be tempered by the realization that these countries could not continue to buy from America as they did during the war with exchange against them continually growing worse. So far as Spain, Holland and the Scandinavian countries are concerned, or at least Sweden, there is rather a leaning toward the purchase of German goods if these can be obtained in anything like the quantity and at the prices of American goods. I was surprised at the comparatively small effort that had been made by many American electrical manufacturers, either before or during the war, to get real business in Holland and the Scandinavian countries, and as one prominent Dutch engineer at The Hague, himself a Fellow of the American Institute of Electrical Engineers, remarked to me: 'It is surprising that American manufacturers have not made any effort to cultivate our requirements and our friendship over here when we are so ready to purchase from the United States, quality and price reasonably considered.' I have never seen in any country engineers more alert, up to date and willing to consider new developments than these same Dutch and Danish engineers that I talked to.

"Naturally, there have been no marked changes or improvements in the meter art in European countries during the war, and so far as quality is concerned, I feel that American manufacturers of meters and similar electrical products have little to fear from European competition. But we must not deceive ourselves by thinking that we can

rest on our oars and assume that European customers will take our goods simply because they are of high grade and well made. Many other factors enter into the situation, first of all the present exchange; next, cost, even at normal exchange; third, service rendered in the way of prompt and correct shipments, good packing, attention from engineering and sales representatives; fourth, attention to the many special details which in themselves seem trivial but which mean so much to the average foreign buyer.

"The market for American electrical product in the countries visited, especially with the dearth of electrical production in these countries during the war, is enormous, and if our manufacturers generally will attack the problem in the light of conditions already mentioned, as some really have done, there is no question that a large and satisfactory sale will await them provided the great and fundamental question of exchange as it now stands with some of the above-mentioned countries can be solved.

"As to Great Britain, there was considerable question last year as to what the attitude of the British government would be on importation of many articles which before the war were absolutely free under Great Britain's well-known policy of free trade. Under the restrictions announced later in the year by the British Board of Trade, it is impossible even now for certain electrical articles to enter at all; that is, it is not a question of any duty but of an absolute embargo to protect some of the British manufacturers who were sadly stricken by the war. On some lines restricted importation is permitted, but only with the provision that at least assembling, and later manufacturing in a considerable degree, shall be carried on in Great Britain.

"It therefore seems especially important that the American electrical manufacturer, contemplating and hoping for an extensive trade in Great Britain and her colonies, should consider at an early date the advisability of a plant in Great Britain or at least at some point in the British Empire."

Metal Market Situation

THERE is little activity in the copper market, but it is strong. Producers are holding at 19.25 cents a pound for second-quarter delivery, but only here and there is there any buying. Consumers are pretty well sold up on second quarter, and producers are not at all anxious to deal beyond that time. It is felt that there will be little buying for a time, until consumers have to come into the market for third quarter, and that will not occur probably until well into the middle of the present period. It seems to be rather common to buy in three months' periods rather than in six.

In the outside market prompt and April copper is quoted at 18⅝ cents to 18¾ cents, with second quarter about 18⅞ cents. Little copper is changing hands.

The transportation tie-up has, of course, stopped the movement of metals, and the output of copper at Eastern refineries has been reduced considerably. They are attempting to keep going in a small way on the small stocks of raw materials on hand until transportation conditions become better again.

NEW YORK METAL MARKET PRICES

	April 7			April 14		
Copper	£	s	d	£	s	d
London, standard spot	105	0	0	104	10	0
	Cents per Pound			Cents per Pound		
Prime Lake	19.25			19.00		
Electrolytic	19.00			19.25		
Casting	18.62½			18.37½		
Wire base	23.00			23.00		
Lead, trust price	9.25			9.25		
Antimony	10.50			10.75		
Nickel, ingot	43.00			43.00		
Sheet zinc, f.o.b. smelter	12.50			12.50		
Zinc, spot	8.85 to 8.95			8.75 to 8.85		
Tin	62.00			63.00		
Aluminum, 98 to 99 per cent	33.00			33.00		

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16.50 to 17.25	16.50 to 17.25
Brass, heavy	10.25 to 10.50	10.25 to 10.50
Brass, light	9.00 to 9.25	9.00 to 9.50
Lead, heavy	7.50 to 7.75	7.50 to 7.62½
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

FROM all sections of the country, demand for roughing and finishing materials is increasing rapidly as the spring building season progresses. Jobbers who heretofore have been unable to do more than 70 per cent of the normal amount of business, either on account of materials being delayed in shipment or because of poor factory conditions and resultant long deliveries, are now seriously affected by the present railroad tie-up. In New York, Boston and Chicago conditions are growing worse than in the South and West. Many truckloads of schedule material, lamps and wire, are being brought into New York, but the total volume is small as compared with normal shipments. No electrical work has been stopped in the metropolitan district, although but little has been started, and a canvass of jobbers indicates that present work can continue ten days without being held up for material.

In Atlanta building construction is going ahead rapidly. A strike there of plumbers, tinners and painters has not held up work as yet. Jobbers are badly in need of conduit and other roughing materials. Strike conditions in Chicago have had little effect on orders received, which continue to pour in. Here the railroad situation is reported as improving.

In the West housebuilding has commenced but may be delayed if materials are held up. Heavy demand has been made for electrical apparatus in fruit and berry canneries.

NEW YORK

In spite of a harbor strike, a rail strike and embargoes on both freight and express, jobbers in the metropolitan district, although badly handicapped by the lack of some much-needed materials, are continuing to do considerable business. Demand continues heavy for roughing materials, such as conduit, flexible armored cable, outlet boxes and wire. This is mostly for new houses in the outlying districts, for remodeling work and for new construction jobs in the city. No freight has been received this week by rail, but between Tuesday and Friday of last week several carloads of conduit arrived, with the result that there is more conduit on hand in the city today than during the past two weeks. The amount, however, is so small that it will not go far, but it will help to tide over many small jobs until more conduit arrives.

In addition, much schedule material, insulated wire, lamps and other products have been brought into the district by truck from Connecticut and from other nearby sources.

Taking all lines into account, the demand has lessened and will probably continue to drop off for another week or so until building schedules are further advanced and until the rail strike is adjusted. Additional manufacturers have issued card 45 on conduit.

Prices have been advanced on conduit by virtually all manufacturers and on flexible armored conductor by at least two manufacturers. Increases are also noted on wireless and radio equipment.

Conduits.—Several cars were received in the latter part of last week, increasing the total amount held in the metropolitan district. This stock is being used to fill back orders. The majority of the jobbers are completely out of pipe. Additional manufacturers have sent out card 45.

Flexible Armored Conductor.—Jobbers generally are completely out. Small quantities are held on a few instances. At least one manufacturer has advanced prices $5 per 1,000 ft. Prices for No. 14 double-strip are quoted at from $104 to $110 per 1,000 ft. and three-wire from $135 to $138.

Lamps.—Stocks are spotty, with here and there breaks in 25, 50 and 100-watt sizes.

Bare Wire.—No change in base from the 22.25 cent level has been reported. Demand is rather slow.

Weatherproof Wire.—Shipments on large sizes are around six weeks, while the smaller sizes are requiring eight weeks or so. Demand is pretty good.

Heating Appliances.—There are a few irons available, but tableware is very short. Jobbers have no large stocks of heaters for the spring season, and those with no stocks report no intention to take in any.

Line Hardware.—Mill shipments are two to four months, but certain warehouses can supply almost any item from stock. Prices are firm, but from at least one quarter an upward tendency is expected. Demand is very good.

Lamp Fixtures.—Industrial types sold better than house fixtures in outlying districts, although the demand in the city for the latter has been good. Sales are on a par with those of April, 1919.

Radio and Wireless Equipment.—One manufacturer has advanced prices on all radio and wireless equipment 10 to 15 per cent. Demand is heavy.

Boxes.—Flexible armored conductor boxes are particularly hard to get. Outlet boxes are generally low in stock. The 4-in. size is more plentiful than the 3-in. size, stocks of which are spotty.

BOSTON

The volume of trade continues to tax manufacturing and jobbing facilities, deliveries being in poor shape in most lines and stocks spotty. Collections are somewhat better than in March, though still below normal. Building contracts and engineering operations signed in New England exceed $88,000,000 to date for 1920, or very nearly double the best previous record. Electrical labor is well employed, and up to this writing there has been no stampede to follow the "outlaw" strikes in New York and elsewhere in the transportation industry. Prices hold firm, with occasional stiffening to obtain preferential service. Transportation conditions have not recovered from adverse winter weather, and present tie-ups in freight movement and curtailments in passenger train service are beginning to burden even distant distributers. Here and there a note of caution is being heard in jobbing circles relative to the wisdom of avoiding heavy purchases in supplies at current prices.

Rigid Conduit.—Stocks are low. The ½-in. black pipe is quoted at $98 per 1,000 ft. and 1-in. at $190. Shipments are very unsatisfactory.

Flexible Armored Conductor.—Little of this material is in the market, but jobbers are handling occasional orders from old customers. A price readjustment is in process amounting to about $10 per 1,000 ft. on No. 14 single-strip. The new level is about $105 to $110, but this does not represent an advance all along the line as some jobbers have been quoting on this basis for two or three weeks.

Non-Metallic Flexible Conduit.—Stocks are spotty, and some jobbers are in fair shape to meet immediate demands, others being virtually out of loom. The 7-32-in. size brings $37 and the ¼-in. size $40 per 1,000 ft. in coil to 1,000-ft. lots.

Wire.—Rubber-covered No. 14 wire is in good supply, with prices firm at $11.50 to $12 per 1,000 ft. in moderate lots. Weatherproof is quoted on a 32-cent base and bare is running around 26 cents to 27 cents.

Lamps.—Labor troubles in New York have begun to hold up shipments to New England. Gas-filled lamps of the 75, 100 and 200-watt size are hardest to obtain.

Sockets.—A good supply is on hand. Pulls were quoted Monday at 47.5 cents to 50 cents net in case lots, with keys at 28 cents and keyless at 26 cents.

Porcelain Fittings.—A few barrels of "Nail-it" knobs have been received within a few days, but the supply is far below the market requirements. Jobbers are getting $32 per 1,000 in barrel lots. Tubes are scarce.

Motors.—Business is very brisk in sizes up to 50 hp. One jobber sold six motors aggregating 95 hp. out of stock Monday and ordered over 100 more, but shipments are uncertain. Stocks are low, on the whole.

Radiators.—Local stocks are in readiness to meet a fair demand when the fires are allowed to go out. It is understood that a well-known type listing at $11 will go to $12 this fall.

Appliances.—Trade continues active in washers and cleaners. Irons are moving well and factory stocks are conspicuous by their absence.

CHICAGO

Transportation troubles complained of a week ago now seem mild in contrast with the effectual railroad tie-up resulting from the so-called "outlaw" strike of switchmen. Shipments of any kind to any destination are today impossible. Every available motor truck in the district is being pressed into service to secure distribution to nearby cities, but, necessarily, perishable goods are the ones receiving the most attention. It is not conceivable that existing conditions will continue for any great length of time. So much derangement of affairs has already occurred that much time will be required to get things back to normal shipping schedule.

All of which seems to have no effect on the volume of orders which is coming in to jobbers and manufacturers. Railroads, which are expected to be in the market for a great deal of equipment in the near future, are already making numerous inquiries. Unusual demand is felt from paper mills, which are buying anything they can get in the way of motor equipment. The Pullman company has also been noted as a recent good customer.

Local interest is keen in the fate of a fifteen-million-dollar bond issue to cover street-lighting rehabilitation and extensions. The measure is facing strong opposition on the ground of economy. Building continues rather heavy, with excellent weather. The week's building permits exceeded $2,000,000, being confined almost exclusively to non-industrial construction.

Power Cable.—Demand exceeds supply. The upper trend of copper has been given as reason for slight increase in price.

Bare Copper Wire.—Reflecting the advance in copper, a new base has been established on bare copper, an increase of 50 cents per 100 lb. over prices recently in effect. No. 8 is quoted at $25.75 in lots up to 200 lb. and at $24.50 for larger quantities. No. 12 brings $26 in small lots and $25 in large. The supply of this size is ample.

Weatherproof Wire.—Deliveries are getting somewhat better, certain manufacturers quoting from thirty to sixty days. An advance of 50 cents is noted.

Tape.—Heavy demand keeps jobbers' shelves bare, deliveries ranging from three weeks to two months. An advanced list went into effect this week. A high grade of tape is quoted at 90 cents in less than 5 lb. lots, 78 cents for 25-lb. lots, 75 cents for 100 lb. Medium grade brings 78 cents for 5 lb., 70 cents for 25 lb. and 60 cents for 100 lb.

Farm Substations.—Manufacturers report a strong demand for single-pole high tension switching substation equipment for farm lighting. This demand is widespread over Canada and the United States and particularly noticeable in the Mid-West and Northwest sections of this country.

Outdoor Industrial Substations.—Unusually heavy demand for high-tension substation equipment is reported from both public utility companies and industrial concerns. Builders are booked up to such an extent that prompt deliveries are impossible.

Sleeving-Solder.—All lead products are following the recent market advance of that metal, current quotation on half-and-half solder being 38 cents per pound. Sleeving is being billed at 10 cents per pound.

Glass Insulators.—New list prices on the Hemingray Glass Company's insulators are as follows: In less than standard package, pony No. 9, $82.50 per 1,000; No. 19, double-groove, double-petticoat, $126.25; No. 62, large groove cable, $194.10. In standard packages these styles are quoted at $49.50, $75.75 and $116.45 respectively, and in lots of from one to ten thousand at $38.75, $59.35 and $91.25. Deliveries are fairly prompt.

ATLANTA

All indications point to a well-sustained volume of business throughout the section. The spring season has stimulated the demand for electrical specialties of the seasonal type, while weather conditions are becoming such as to permit of the pushing of all types of building construction. Jobbers continue to complain of the poor shipments of material requiring steel or porcelain in its manufacture and all local stocks of this class of material have become badly depleted.

Builders report that the recent strike of the tinners, plumbers and painters in Atlanta has had no appreciable effect on building activities in the city, nor do they anticipate that the carpenters' strike scheduled for May 1 will be successful in tying up local building activities. April building permits for the first week in the month reached a new high level, and builders hope for a sufficient supply of labor even in the face of the threatened strike.

Reports from jobbers indicate that collections are slightly improved over this time last month. A number of jobbers are commencing to use trade acceptances. Bank clearings are approximately 40 per cent in excess of the same period last year.

Conduit.—Pipe continues as scare as heretofore, with no slackening in demand. A price advance of from 5 to 10 per cent has been registered.

Exhaust Fans.—In response to a seasonal demand, exhaust fans have commenced to move briskly and jobbers are reporting the receipt of large orders. Fair stocks have accumulated in the territory during the winter, so shipments are good. Price, 32-in. size, $159.

Flexible Armored Conductor.—One jobber reports the receipt of a large shipment on order since last December. This shipment will be sufficient to take care of all apartment house requirements in this city, permitting construction which had been held up because of the lack of this class of material. Price, two-conductor, No. 14, 1,000 ft. to 2,500 ft., $11.60 per 100 ft.

Outlet Boxes.—A fair supply of obsolete-type boxes is available, but the popular sizes are reported scarce, with shipments unsatisfactory.

Storage Batteries.—Stocks of the more standard types are reported fair, although difficulty is being experienced in obtaining batteries in anything but the standard type. Slow shipments, however, are serving to deplete local stocks badly. A price advance of 14 per cent has been applied to electric vehicle batteries.

Lamp Cord.—Jobbers report that stocks are low, with shipments at three months. Brisk demand will prevent an accumulation of sufficient supplies of this article for fall trade. Prices, 1,000 ft. to 5,000 ft., $3.50 per 100 ft.

SEATTLE—PORTLAND

Both jobbers and retailers in the Seattle territory report trade volumes during the past week holding to levels set during March, the only deterring factor being lack of stock. This is the chief difficulty, and the shortage includes not only household appliances but wiring devices and power apparatus as well. The proposed campaigns on labor-saving devices have been postponed indefinitely; in fact, stocks are not nearly adequate to meet the constantly increasing demand. Building activity continues at a rapid pace in spite of restrictions due to shortage of schedule materials. Apparently prospective home builders have come to realize that to wait for lower prices of lumber and other building materials is futile and they have determined to proceed with construction.

Weather conditions in the Puget Sound territory are ideal. Agriculture, both in number of persons employed and acres cultivated, is steadily increasing in the Pacific Northwest, and almost every locality is engaged in an enterprise that will enhance the acreage under cultivation either for fruit and berries or irrigated farming. Spring wheat has not had all the moisture that is desirable, but accurate crop predictions are impossible at this time. The outlook, however, is generally favorable. Inquiries and orders are being received by jobbers for power apparatus and electrical equipment used in berry and fruit-canning plants.

Lumber mills in the Northwest are operating at practically full capacity to keep up with persistent demand coming from all parts of the country. Reports from various Northwest cities indicate that labor is well employed. Building and electrical contractors in Spokane recently declared an open-shop policy following a demand of workmen for higher wages.

Mangles.—Both Seattle and Tacoma dealers report increasing inquiries and some sales, following unprecedented movement of electric washers. One large Seattle dealer states that while housewives of means are showing considerable interest in the mangle there is some hesitancy in placing orders. Sales are not being pushed because of short stocks.

Sewing Machines.—Retail price of one vibrating style advanced approximately 10 per cent recently, although jobbers state that this apparently has not slowed up sales. Stocks are low and replacements hard to obtain.

Sockets.—In face of increasing demands stocks are practically exhausted and shipments are poor. Shipments reported en route may arrive in Seattle in time to save the day. Rural demand is the heaviest in years.

SAN FRANCISCO

A serious tie-up is threatened by the strike of yardmen and switchmen on all the California steam railroads. San Francisco and Oakland are still concerned, but it is reported that interior junctions have complied with the demands and are operating as usual. This tie-up comes at a very serious time, affecting the movement of citrus fruits and other perishables. A linemen's strike on the lines of the Pacific Gas & Electric Company is under way, although business, to outward seeming at least, is proceeding as usual.

Schedule Material.—The most popular socket device is the two-way or double-duty socket in various makes, because of the enormous increase in the marketing of socket devices. This demand parallels for the smaller devices the demand created by the co-operative campaign for baseboard receptacles for the larger household appliances which was recently carried on.

Electric Drills.—Recently efforts have been made to promote the regular use of electric drills and hammers in various industrial shops and in the shipyards and this effort is making headway. Electrical rivet-heating machines will also be marketed in this district.

Motors.—There never was a greater demand for motors of all sizes than there is now, ranking from big motors in reconstructed plants to fractional horsepower motors for manufactured products of which they are a part. Deliveries, which were formerly poor for single-phase styles but fair for other types, are now universally poor. Some dealers in second-hand and repaired motors are refusing absolutely to sell, finding the renting business during the present scarcity more profitable.

Heating Material.—A new schedule of American Beauty heating devices is being introduced into the territory. Based strictly upon the quantity in each individual order, this practice is very different from the Hotpoint yearly contract. Deliveries are better, the surprise of the past week being a large shipment of percolators, all of which were applied against long-standing orders.

Wire.—Prices on office and annunciator wire have increased 10 per cent, No. 18 now selling at about 56 cents per lb. in 50 lb. assorted quantities. Deliveries are good. Rubber-covered wire, size No. 14, in 5,000-ft. assorted lots sells for $12.30 per 1,000 ft. f. o. b. Coast houses. Deliveries are good. Lamp cord has jumped about 10 per cent in standard sizes and now sells in 2,500-ft. assorted lots at about $28 per 1,000 ft. for No. 18 cotton-covered twisted and $37 per 1,000 ft. for the light reinforced style. It is probable that light cord will be permitted for fixture work during the rest of the year.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

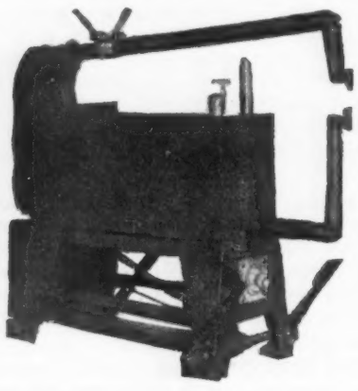
Lead-Covered Battery-Connecting Clip

A battery-connecting clip adjustable to any diameter up to 1¾ in. is being put out by the Reliable Manufacturing Company, 2814 Prospect Avenue, Cleveland, Ohio. This clip, known as the "Bulldog," is heavily lead-coated and made in two pieces with spring jaws and a clamp which may be adjusted on the jaw to grip different-sized terminals. The wire lead is soldered in the clamp. Contact is made on the battery terminal by sawtooth jaws. The grip is rated at 50 amp.

SLEEVE ADJUSTED FOR DIFFERENT SIZED TERMINALS

Spot Welder

A spot welder with its transformer built into its throat has been developed by the Automatic Controller Manufacturing Company, Ogden, Utah. The size of throat in one model is 52 in. and in two other models 42 in. The transformer is built into the throat of the welder, enveloping a portion of the lower arm and thus permitting a throat almost the full length of the machine. The electrodes are made with a tapered shaft for quick changing. Four foot treads are provided. The cooling system is confined within the throat member. The regular equipment is made for connection to running water, but a special syphon pump may be had. The largest machine occupies a floor space of 67 in. x 24 in. and is 48 in. high. The shipping weight is about 900 lb. These welders are built for 110/220 and 440 volts, at 25, 40 and 60 cycles.



TRANSFORMER FORMS PART OF THROAT

Portable Tilting Lamp

H. G. McFaddin & Company, 38 Warren St., New York City, have recently put on the market the Dresalite, a portable lamp equipped with an adjustable shade which can be tilted or turned to deflect the light in any direction. The fixture can be attached by two small screws to the back of the mirror frame or support of the dresser or to the head of the bed.

Portable Switchboard for Studio Work

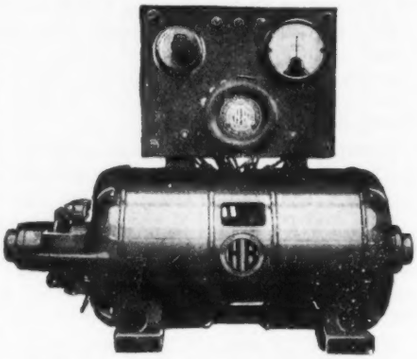
A portable switchboard has been specially designed for motion-picture studios by the Krantz Works of the Westinghouse Electric & Manufacturing Company, Brooklyn, N. Y. It consists of a slate panel on which are mounted six three-pole, single-throw, 125-amp. knife switches. Each knife feeds to a three-point Kliegle receptacle and is capable of taking care of one six-way Kliegle spider box. The switches, receptacles and plugs are contained in a No. 12 gage steel box, and two swinging doors permit access to the switches. The doors may be secured and contact with live parts thus made impossible. Connection is made to the main line at the top of the switchboard, and six circuits may be operated simultaneously if required. The outstanding feature of this switchboard is its portability. It is mounted on four wheels and can be quickly and easily moved from one part of the studio to another.

Large-Size Nitrogen Lamp

Believing that the success of the small 50-watt milk-white nitrogen lamp has created a demand for a lamp embodying the attractive features of this type but with longer life and greater illumination, the Liberty Appliance Corporation, New York City, has developed a new line of nitrogen lamps, called "Liberty Nitrogen Opalites." The new lamps are similar to the C-4 lamps, except that they are not tipless and come only in larger sizes, 100-watt and 200-watt. In these larger sizes, the maker says, the lamps give the same soft, radiant diffused light as do those of the smaller size; but, made in these sizes, they make it possible for each socket to contribute greater illumination where it is frequently needed without the necessity of additional wiring or other attachments. Hospital operating rooms, opticians' offices, stores and homes requiring unusually good diffusion of light will find these lamps especially applicable, the maker declares.

Battery-Charging Outfit

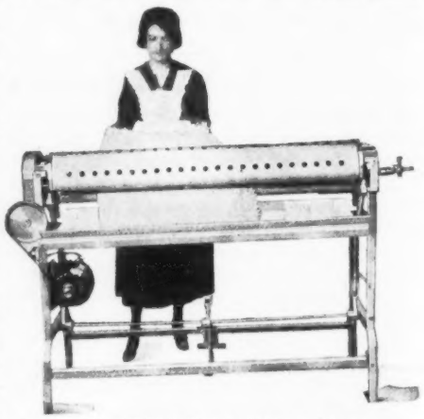
A new 250-watt battery-charging outfit made by the Hobart Brothers Company, Troy, Ohio, is designed for recharging from one to four automobile starting and lighting batteries at one time. This outfit has ball-bearing motor and generator, automatic voltage control, allowing different voltage batteries to be charged at the same time, and a complete panelboard with meters mounted on top of the motor-generator.



CHARGES FROM ONE TO FOUR BATTERIES

Ironing Machine with Gas-Heated Shoe

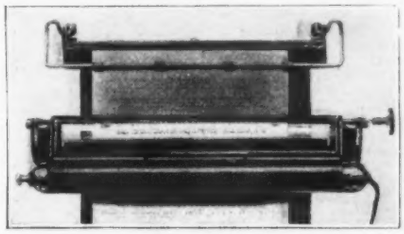
An ironing machine with gas-heated shoe and motor-driven roller has recently been brought out by the Barnett Foundry & Machine Company, Irvington, N. J., under the trade name "Capitol." A feature of the machine is the method of control of the motor and roller by a foot lever, which is arranged so that the hands are left free for handling and guiding the materials to be ironed. All gears are covered by guards.



CONTROLLED BY FOOT LEVER

Lighting Device for Stenographers

A device for lighting and magnifying the copy which is being read by the operator of a typewriter has been developed by the Lineatime Manufacturing Company, Inc., Rochester, N. Y. This device, which is to be mounted at



LIGHTS AND MAGNIFIES ONE LINE

the back of the typewriter, illuminates one line of the copy at a time, which is seen magnified through a longitudinal lens designed, the manufacturers say, to filter out some of the injurious light rays.

Combined Ceiling and Reading Light

An ornamental lighting fixture with a center lamp that may be pulled down close to a table for use as a reading lamp has been developed by the Majestic Heater Company, San Francisco,

MIDDLE LAMP PULLED DOWN FOR READING

Cal. Ordinarily the fixture has the appearance of the common four-light fixture, but the center lamp has a flexible cord wound on a reel in the fixture which unwinds when the lamp is pulled down.

One-Twentieth-Horsepower Motor

A split-phase induction-type motor of 1-20 hp. at 1,725 r.p.m. has been developed by the Bodine Electric Company, 2256 West Ohio Street, Chicago. The manufacturers claim liberal proportioning of all parts subject to wear, regardless of the small size of the motor. Substantially the same cut-out mechanism is used as in the larger-size motors of the same manufacture. It is considered by the makers essential that this cut-out mechanism shall be such as to insure uninterrupted service, no matter how small the motor. Two larger sizes of the same general construction are being developed and will be offered as soon as production is under way.

Collapsible Canvas Tool Bag for Linemen

The Industrial Products Company, Philadelphia, has put on the market a canvas tool bag for use in hoisting tools, paint and other implements or supplies. The bag is made with no metal parts which can come into contact with the current, as the sides are of canvas, the bottom is of wood and the handle is of rope. The manufacturers have designed it to hold tools and materials which, if not properly taken care of, may be a menace to those below.

Small Lighting Plant

A small generating plant for operation on kerosene or gasoline has been developed by the Matthews Company, Port Clinton, Ohio. This plant, known as the "Ker-o-el," is rated at 800 watts to 1,000 watts at 32 volts and is equipped with either an 80-amp.-hr. or a 160-amp.-hr. battery. Air cooling is used for farm operation and water cooling for marine work. It is self-cranking and has an automatic stop to operate when the battery is fully charged. The control board is mounted over the generator and is fitted with a fused line switch, an ampere-hour meter and a starting-box circuit breaker. The set weighs 270 lb. exclusive of the battery, which weighs 420 lb. for the 80-amp.-hr. size and 525 lb. for the 160-amp.-hr. size. It measures 26 in. x 24 in. x 15 in. with a 12-in. x 18-in. bed plate.

Double-Duty Cluster with Individual Lamp Control

The double-duty cluster recently brought out by the Peerless Light Company, Washington Boulevard and Union Street, Chicago, is so named, the maker says, because it combines simplicity of construction, artistic appearance and service.

The cluster is a one-piece casting, and its construction, it is said, is designed to counteract the jarring effects of switching the lights on or off. It is equipped with two pull-chain

DOUBLE-DUTY CLUSTER MADE OF A ONE-PIECE CASTING

sockets, giving individual control of the lamps.

In another form the cluster is completed with one keyless socket and one pull-chain socket, so wired that both lights are controlled by one motion.

Notes on Recent Appliances

Automatic Unit Battery-Charging Section

For charging electric trucks by the constant-potential method, the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has put out an automatic unit battery-charging section.

Separatorless Storage Battery

Storage batteries without separators are being offered by the Electrolyte Storage Battery Company, 1309 Race Street, Philadelphia.

Built-up Commutator Resurfaced

The Ideal Commutator Dresser Company, 6 South Dearborn Street, Chicago, Ill., has designed a new commutator resurfacer which is to be used with a portable or side-attachment resurfacing machine.

Small Oscillating Fan with Adjustable Base

A 9-in. oscillating fan with a base which may be adjusted for mounting on a wall has been perfected by the Emerson Electric Manufacturing Company, St. Louis, Mo.

Indicating Ohmmeter

An indicating meter for measuring resistance of an electric circuit or portion thereof in the same manner that voltmeters measure pressure has been perfected by the Thompson-Levering Company, 325 Arch St., Philadelphia.

Conduit Bender

The Rattan Manufacturing Company, New Haven, Conn., is putting out a conduit bender with curved jaws.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

MAJOR CARL H. REEVES has been appointed superintendent of public utilities by Mayor Hugh M. Caldwell, of Seattle, Wash., as successor to Thomas F. Murphine, resigned. Major Reeves has had many years' experience in railway engineering and in the construction of public utilities, having served in the city engineer's office for several years. From 1906 to 1915 he was assistant engineer with the Seattle Electric Company, resigning in 1915 to perform special work for the State Public Service Commission. Since 1916 he has been in private practice in Seattle, except for about three months' service with the United States Army, when he had charge of construction work at Camp Fremont and at Puget Sound forts.

T. J. PACE, formerly industrial assistant to manager of supply department, has recently been appointed assistant manager of the supply department of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Mr. Pace has been

T. J. PACE

actively identified with the electrical industry along supply lines with Westinghouse and allied interests for about twenty years. A portion of this time was devoted to commercial and engineering work in lighting applications. In this work he has been prominently connected with a number of the larger of the present-day street lighting installations and has presented a number of papers before the various engineering organizations on this and other subjects. He has been a leading advocate of standardization within the industry. More recently Mr. Pace has devoted a large part of his time to industrial applications of electricity and to popularizing the use of electrical devices, including safety electrical appliances, in industrial plants.

THE ROLLER-SMITH COMPANY, 233 Broadway, New York City, announces the appointment of Hammond D. Baker as manager of its Detroit (Mich.), office at 1202 Majestic Building. Mr. Baker, a graduate electrical engineer of Alabama Polytechnic Institute, after his discharge from the aviation service of the army, became connected with the United Motors Corporation as technical traveling representative. Later he joined the sales department of the Hoskins Manufacturing Company, Detroit, Mich., from which he resigned to accept the appointment with the Roller-Smith Company.

THE YARNALL-WARING COMPANY, Chestnut Hill, Philadelphia, announces that D. T. Newman, formerly connected with the Philadelphia sales office, has been placed in charge of the Atlanta (Ga.) office which was recently opened in the Candler Annex, Atlanta, Ga.

THE VALLEY ELECTRICAL COMPANY, St. Louis, Mo., has awarded contract for the construction of a new industrial plant on King's Highway Boulevard, between Kemper Park and Connecticut Street, to cost about $300,000. The company has recently taken over the business and property of the St. Louis Electrical Works, now at 4060 Forest Park Boulevard, St. Louis, Mo.

THE STAROBIN ELECTRICAL SUPPLY COMPANY, 101 Fourth Avenue, New York, manufacturer of electrical supplies, has increased capital stock from $30,000 to $100,000.

THE SIMMS MAGNETO COMPANY, North Arlington Avenue, Orange, N. J., manufacturer of magnetos and ingnition systems, has awarded contract for an addition to its plant, to cost with equipment about $385,000.

THE CLOX-LIGHT MANUFACTURING COMPANY, 24 Scott Street, Newark, N. J., recently organized to manufacture controller devices for automobile lighting systems, is arranging for an increase in capital stock to $500,000, the proceeds to be used to increase the capacity of its plant. Werner O. Olsen is president.

THE WICO ELECTRIC COMPANY, Springfield, Mass., has filed articles of incorporation under the laws of Massachusetts with a capital stock of $400,000 to manufacture magnetos, storage batteries, ignition equipment, etc., in its West Springfield plant. Phelps Brown, 44 Avon Place, is president.

THE PHILADELPHIA STORAGE BATTERY COMPANY, Ontario and C Streets, Philadelphia, is planning to make alterations and improvements in its plant to cost about $35,000.

ELECTRICAL SHOW IN COLUMBUS.—The first annual electrical show held under the auspices of the Columbus (Ohio) electrical dealers was open for the week of April 5. The show was designed to teach the public the wonderful improvements in electrical fixtures and appliances and to educate the people in the proper use of electricity. All of the local dealers and many of the manufacturers had large exhibits at the show.

RUSSELL P. ASKUE has severed his connection with the publicity department of the National Lamp Works, Cleveland, Ohio, to go into agency work with headquarters at Cleveland. Mr. Askue had been with the National Lamp Works for several years, prior to which he was advertising manager for the Ivanhoe Regent Works of the General Electric Company.

THE WEBER ELECTRIC COMPANY, Schenectady, N. Y., manufacturer of electrical supplies, contemplates the erection of an addition to its plant, 65 x 100 ft., to cost about $25,000.

THE A. A. WIRE COMPANY, 50 East Forty-second Street, New York, has filed notice with the Secretary of State of an increase in its capital stock from $100,000 to $800,000.

THE FRANK ADAM ELECTRIC COMPANY, St. Louis, Mo., manufacturer of switchboards, panels, cabinets, electrical equipment, etc., is breaking ground for a new factory addition. This is the second time within a year and a half that the company has been forced to build. The new building will follow the general line of the present plant, and when completed it will cover practically an entire city block on Windsor Place and St. Alphonsus St., nearly doubling the capacity and floor space of the present plant.

E. C. RUTZ and P. E. WIDSTEEN, formerly with the Woodmansee-Davidson Engineering Company, consulting engineers, announce the incorporation of the R. & W. Construction Company, to specialize in power plant and transmission line construction for public utility and industrial development. The company has established offices at 35 South Des Plaines Street, Chicago.

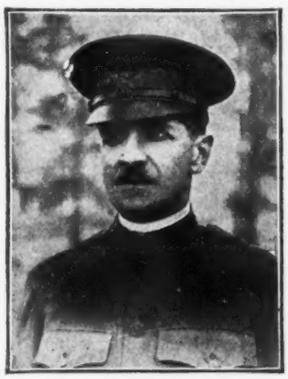
THE UTILITIES ENGINEERING & ACCOUNTING COMPANY announces that it has opened an office at 10 South Second Street, Harrisburg, Pa., in charge of William C. Rommel, formerly rate expert for the Public Service Commission of Pennsylvania.

THE O. K. WELDING COMPANY, Henryetta, Okla., recently incorporated with a capital stock of $75,000, plans to erect a machine shop and foundry.

GOVERNMENT SURPLUS MOTORS FOR SALE.—At the United States government warehouse No. 193, Remington Arms (U. M. C. plant), Bridgeport, Conn., there are 150 three-phase, 60-cycle, 440-volt General Electric and Westinghouse motors for sale, most of them 870 r.p.m. and 1,160 r.p.m. G. E., from 97 to 100 per cent condition. There are also nineteen Crocker-Wheeler and Wagner 220-volt motors, from 1 hp. to 15 hp., 1,140 r.p.m., and in good condition.

THE VOLTA MANUFACTURING COMPANY, LTD., Welland, Ontario, Canada, recently incorporated with a capital stock of $200,000, will acquire and take over the property and business of the Volta Manufacturing Company, manufacturer of electrical machinery, tools, equipment, etc.

JOSEPH H. LECOUR has been elected treasurer of the Mitchell-Rand Manufacturing Company, New York, manufacturer of electrical insulating materials, succeeding in this capacity W. E. G. Mitchell, whose duties as vice-president require all of his attention. Mr. Lecour, who is well known in the electrical and affiliated industries, was born in New York and was



J. H. LECOUR

graduated from Trinity College in 1898 and from the New York Law School in 1900. He was admitted to the bar of this state in the latter year and to the New Jersey bar in 1905. During the war period Mr. Lecour served with the Essex Troop of New Jersey on the Mexican border and later with the 112th and 124th Field Artillery. He was also on the staff of the First American Army.

JOHN W. HOOLEY, contracting electrical engineer, 95 Liberty Street, New York City, announces that after May 1 he will be located at 45 Barclay Street, where he will occupy the entire second loft. This change is being made in order to combine office, shop and stockroom on the same premises.

THE EDISON ELECTRIC APPLIANCE COMPANY, Chicago, is planning to erect a two-story office and storage building to cost about $125,000.

E. E. HEDLER has recently been appointed Eastern representative of the Buckeye Electric Division of the National Lamp Works of Cleveland, Ohio, succeeding W. O. Conley, who has had his headquarters in Philadelphia. Mr. Hedler is well known in electrical circles in the East, having been associated with the Western Electric Company and the Electric Service Supplies Company.

THE INTERNATIONAL ENGINEERING & MANUFACTURING COMPANY, South La Salle Street, Chicago, contemplates establishing a plant in Kokomo, Ind., to cost about $100,000, for the manufacture of low voltage farm electric lighting and power plants.

W. H. SMAW, purchasing agent for the Georgia Railway & Power Company, Atlanta, resigned March 1 to become Southern sales representative of the Electric Service Supplies Company, Philadelphia, manufacturer and jobber of electrical supplies and street railway specialties. Mr. Smaw joined the Georgia company in 1903 as assistant purchasing agent and in 1910 became purchasing agent.

A. E. VIENNEAU has been placed in charge of sales of wiring devices in the Philadelphia office of the Cutler-Hammer Manufacturing Company.

Supply Jobbers' Notes

THE STUART-HOWLAND COMPANY, electrical supply jobber, Boston, is receiving the congratulations and best wishes of the electrical trade on the occasion of the twentieth anniversary of the house, which was reached on April 2.

GEORGE T. FISHER, formerly general superintendent of the Cumberland County Power & Light Company, Portland, Me., has joined the sales staff of the Pettingell-Andrews Company, Boston. Mr. Fisher is well known in the New England central-station field, having served in both the commercial and operating branches of the industry.

THE ERNER & HOPKINS COMPANY, electrical jobbers, Columbus, Ohio, whose place of business was almost totally destroyed by fire on April 1, has opened temporary quarters at 267½ North High Street. Some of the stock in the establishment was salvaged, and with other stock coming in the company is able to continue business in many lines. Its construction work will hardly be interrupted and much of the retail business can also be looked after. The officers of the company will soon start the erection of a modern business block to replace the structure destroyed by fire.

Foreign Trade Notes

ELECTRIC HEATING APPARATUS NEEDED IN FOREIGN COUNTRIES.—In the countries of South and Central America, in India, in Shanghai and the Far East there is an increasing demand for electric heating and cooking apparatus. According to reports there is great difficulty in getting electrical supplies, particularly irons, in these countries.

DEMAND FOR ELECTRICAL APPARATUS IN NETHERLAND INDIES.—According to reports there is an increasing demand in the Netherland East Indies for electrical supplies of all kinds, including electric lighting sets, electrical fittings and accessories, incandescent lamps, etc. Before the war a good deal of electric plant equipment, etc., was supplied by German manufacturers.

THE ROLLER-SMITH COMPANY, 233 Broadway, New York City, announces the appointment of the American Manufacturers' Export & Import Corporation, Seattle, Wash., as its agent for China. The latter company has branch offices in Shanghai, Hong Kong and Hankow, the Shanghai office being in charge of R. L. Stevens, vice-president, formerly with Byllesby & Company. The other two offices are in the hands of H. C. Best and Samuel Wong, respectively. In addition to the Roller-Smith Company, the American Manufacturers' Export & Import Corporations represents the Wagner Electric Company and several other American manufacturers of electrical apparatus.

ROTARY SNAP SWITCHES.—Rotary snap switches are coming rapidly to the fore in England as they enable many switching operations hitherto impracticable or effected with difficulty by tumbler-type switches to be performed with ease. In no sphere perhaps is this superiority felt to be so apparent as in the control of heating and cooking apparatus. These switches are available in a multiplicity of types performing widely varying operations. The General Electric Company, Ltd., has accepted the sole agency in England for the "H & H" rotary snap switches and other specialties manufactured by the Hart & Hegeman Manufacturing Company. Arrangements have been made whereby representative stock will be held by the General Electric Company at its various branches throughout the country.

AMALGAMATON OF LAMP WORKS IN JAPAN.—The Tokyo Electric Company and the Dai-Nippon Electric Lamp Company, the two largest lamp works in Japan, have recently been consolidated into one organization. The former has been manufacturing incandescent lamps for many years, using General Electric patents, while the latter is a comparatively new concern. A patent litigation which has been under way for a few years has finally been settled.

GERMAN TRADE WITH GREAT BRITAIN.—The American Chamber of Commerce calls attention to the fact that direct imports from Germany to England, although small in quantity, are gradually extending and cover a much wider range than a few weeks ago. Cargoes recently discharged at Grimsby, Liverpool and London included among other goods flashlight batteries and magnetos.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An electrical engineer in Argentina (No. 32,442) desires to secure an agency for the sale of electrical appliances in general, especially for lighting and heating, electrical machines, motors, cables, electrical measuring instruments and laboratory instruments.

L. G. Hawkins of L. G. Hawkins & Company, 116 Charing Cross Road, London, W. C. 2, England, European representative of Landers, Frary & Clark, announces that he will arrive in America on April 17. He writes that he is particularly interested in labor saving appliances.

Joseph Clarke & Company, National Mutual Buildings, 143 Hereford Street, Christchurch, New Zealand, would like to secure agencies for electrical goods and copper cables.

A firm of engineers and contractors in Siberia (No. 32,473) desires to get in touch with manufacturers and exporters in order to secure agencies in Russia and Siberia for electrical machinery, etc.

Trade Publications

SCREW-CUTTING AND GAGING SYSTEMS.—The new S. T. D. gage catalog, recently issued by the Greenfield Tap & Die Corporation, Greenfield, Mass., in addition to being a catalog includes graphic tolerance charts, and complete gaging systems are shown. The latest methods in "precision" measuring and inspection are given prominence.

LIGHTING FIXTURES.—The Central Electric Company, 316-326 South Wells Street, Chicago, has issued bulletin No. 75, describing its Maxolite diffuser and fixtures for industrial lighting. Illustrations are given of the Maxolite diffuser, RLM standard dome reflectors, fixtures, cut-out hangers, etc.

INSULATING MATERIALS.—The Mitchell-Rand Manufacturing Company, New York, N. Y., has issued catalog No. 262, entitled "Everything in Insulation." It contains seventy-two pages and gives data and prices of insulating material, including tapes and webbings, varnished materials, varnishes and paints, mica, soldering paste, armature twines, friction tape and splice, vulcanized fiber, carbon and brushes, asbestos, adhesives, insulating waxes and compounds, etc.

PORCELAIN INSULATORS.—In bulletin No. 62, distributed by the Lapp Insulator Company, Inc., Le Roy, N. Y., a comparison of American and European high-voltage pin-type porcelain insulator designs is given. Curves are included.

SPRAY COOLING SYSTEM.—E. B. Badger & Sons Company, 63-75 Pitts Street, Boston, has issued bulletins Nos. 100 and 102, describing methods of cooling water and air by the spray system.

New Incorporations

THE WICO ELECTRIC COMPANY of Springfield, Mass., has been incorporated under the laws of Massachusetts with a capital stock of $400,000 to manufacture magnetos, storage batteries, ignition equipment and specialties. The officers are: Phelps Brown, 44 Avon Place, president; Arthur W. Lamson, Vice-president, and Edward L. Stoughton, treasurer.

THE ATLAS MANUFACTURING COMPANY, Port Arthur, Ont., Canada, has been incorporated by Alexander C. Lotoski, Amos C. Allen, Walter L. MacGregor and others. The company is capitalized at $40,000 and proposes to manufacture electrical supplies, machinery, etc.

THE SOUTHERN ELECTRICAL & EQUIPMENT COMPANY of Charlotte, N. C., has been incorporated with a capital stock of $100,000 to manufacture electrical appliances, etc. L. H. Hardin is general manager.

THE CONNERSVILLE (Pa.) ELECTRIC STEEL COMPANY has been incorporated with a capital stock of $195,000. The officers are: G. M. Gadsey of Pittsburgh; F. E. Markell, treasurer.

THE MASTER ELECTRIC COMPANY, 460 Bacon Street, Dayton, Ohio, has been incorporated by R. G. Corwin, John H. Larsh, S. A. Brown and A. C. Jackson. The company is capitalized at $50,000 and proposes to manufacture pumps and other electrically driven machinery.

THE KENTUCKY SWITCH & SIGNAL COMPANY of Louisville, Ky., has been incorporated by R. V. and L. Cheatham of St. Matthews; W. S. Scoggan of Sanford, Fla., and R. R. Scoggan of Jeffersonville. The company is capitalized at $16,000 and proposes to manufacture appliances for electric and steam railroads.

THE TEXAS BATTERY COMPANY of Dallas, Tex., has been incorporated with a capital stock of $20,000 to manufacture electric batteries, by E. R., H. B. and R. L. Tennant.

THE VOLTA MANUFACTURING COMPANY, LTD., of Welland, Ont., Canada, has been incorporated by Robert T. Turnbull, John Young, John W. Simpson all of Welland; Charles W. Sims of St. Catherines. The company is capitalized at $200,000 and proposes to take over the property and business of the Volta Manufacturing Company, manufacturer of electrical machinery, tools, equipment, iron, steel and other metals.

THE MORGAN CRUCIBLE COMPANY OF AMERICA has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $3,000,000 to manufacture electrical machinery, etc. The incorporators are: Ira L. Anderson of East Orange, N. J.; George Edwards of Bellrose, N. Y., and Harry E. C. Mills, New York City.

THE COLONIAL CHANDELIER WORKS of New York, N. Y., has been incorporated by G. S. Fulton and J. and H. W. Gross, 1017 Intervale Avenue, New York, N. Y. The company is capitalized at $100,000 and proposes to manufacture lighting fixtures.

THE WILLYS LIGHT & POWER COMPANY, of Syracuse, N. Y., has been incorporated with a capital stock of $10,000 by C. B. and V. I. Wheeler and C. A. Schneider. The company proposes to operate local electric light and power plant.

THE HUDSON ELECTRIC APPLIANCE COMPANY of West New York, N. J., has been incorporated by Davis, M. A. Rosenberg and D. J. Delaney. The company is capitalized at $25,000 and proposes to manufacture electrical appliances.

THE STAFFORD ELECTRICAL COMPANY of Buffalo, N. Y., has been incorporated with a capital stock of $10,000 to manufacture electrical goods. The incorporators are: H. C. and E. J. Stafford and L. Jaworski of Buffalo.

THE CEDAR KEYS (Fla.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $10,000 to install electric light and power plant, water works, and ice plant. L. A. Stoler is secretary and treasurer.

THE BINGHAMTON (N. Y.) ELECTRIC TRUCK COMPANY has been incorporated with a capital stock of $200,000 to do a general auto business. The incorporators are: H. C. Warner, F. S. Matthews and W. H. Riley of Binghamton.

New England States

BROCKTON, MASS.—The question of requiring the Edison Electric Illuminating Company of Brockton to place its wires underground on High Street is under consideration by the Board of Aldermen.

HOLYOKE, MASS.—Contracts amounting to more than $63,000 have been awarded for machinery for the municipal electric light plant. The equipment, which will increase the output of the plant from 10,000 kw. to 13,000 kw., includes two boilers, superheaters and automatic stokers. John J. Kirkpatrick is manager.

EAST HAMPTON, CONN.—The Central Connecticut Power and Light Company is erecting a new electric transmission line from Hartford to Glastonbury. Owing to the high cost of construction the company has abandoned any further development of water power and, it is understood, will purchase energy from the Hartford (Conn.) Electric Light Company.

NEW HAVEN, CONN.—A permit has been granted to the United Illuminating Company for the erection of a power house on Grand Avenue, to cost about $48,000.

NEW HAVEN, CONN.—Contract has been awarded by the National Folding Box Company for alterations and improvements to its power plant at Alton and James Streets to C. W. Blakeslee & Son, Waverly Street, New Haven.

NEW HAVEN, CONN.—The Sperry Engineering Company of New Haven has been awarded the contract for the construction of the new silk mill for Charles Wimpfheimer. Several buildings and also a power plant will be erected in connection with the proposed works.

Middle Atlantic States

BUFFALO, N. Y.—A special meeting of the stockholders of the Buffalo General Electric Company will be held April 20 for the purpose of authorizing an issue of $5,000,000 in debenture bonds, and increasing its capital stock from $10,000,000 to $25,000,000.

BUFFALO, N. Y.—Bids will be received by Edward F. Jaeckel, clerk of Board of Supervisors of Erie County, until April 20, for furnishing and installing complete electric light and power equipment in the new county hospital at Wende.

CHURCHVILLE, N. Y. — The Public Service Commission has granted the village of Churchville permission to construct and operate municipal electric light and power plant.

ELMIRA, N. Y.—A bill has been introduced in the State Legislature authorizing the city of Elmira to establish a municipal electric light plant.

GOWANDA, N. Y.—Plans have been prepared by Charles E. Eaton, Sherman Building, Watertown, for construction of a power plant for the Iroquois Utilities Corporation on Cattaragus Creek at Gowanda to cost about $150,000. The equipment will include three 500-hp. generating units.

NEW YORK, N. Y.—Preliminary plans are being prepared for the erection of a telephone exchange at Vesey, Barclay, West and Washington Streets, to cost about $750,000, for the New York Telephone Company. McKenzie, Voorhees & Gmelin, 1123 Broadway, are engineers.

QUEENS, N. Y. — Contract has been awarded by the Borough Council for the construction of a new electrically operated pumping station at Sutter and North Conduit Avenues, including the installation of machinery, to the Fox Reynolds Company, 81 East 125th Street, New York City. The cost is estimated at about $125,000.

SALAMANCA, N. Y. — The Salamanca Panel Company is planning to install a 200-hp. electrically driven plant. Equipment will include two 50-hp. motors, one 15-hp. motor, five 10-hp. motors and several 5-hp. motors.

SARDINIA, N. Y.—The Holland-Sardinia Light & Power Corporation, recently organized with a capital stock of $150,000, has petitioned the Public Service Commission for permission to construct a hydroelectric plant on Sardinia Creek.

CAMDEN, N. J. — A large electrically operating crane, complete loading and unloading machinery, as well as other electrical and mechanical equipment will be required in connection with the construction of the proposed new pier, wharf and warehouse by the Harbor Commission at the foot of Spruce Street, Delaware River.

TRENTON, N. J.—Plans have been completed by the City Commission for improvements and extensions to the street-lighting system in the center district of the city as well as the outlying sections. It is proposed to install a large number of 600-cp. Mazda lamps to replace the present arc lamps and also 400-cp. and 100-cp. lamps in the outlying districts. Plans are also being prepared for the installation of a new lighting system in Upper Stacy Park.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

CARLISLE, PA.—Work has been started on the construction of the proposed new power house at the carpet manufacturing works of E. C. Beetem & Sons on East Luther Street. The cost, including machinery, is estimated at about $50,000.

MUNHALL, PA.—Plans have been completed by the Duquesne Light Company of Pittsburgh for the construction of a new substation in Munhall.

PHILADELPHIA, PA.—Bids will be received by William S. Twining, director Department of City Transit, 1211 Chestnut Street, Philadelphia, until April 20, for work on restoring conduits and cables in south side of city hall.

MILFORD, DEL.—Improvements to the municipal electric light plant, to cost about $20,000, are under consideration by the Town Council.

CHARLESTON, W. VA.—The Virginia Power Company is contemplating an addition to its Cabin Creek plant, including the installation of a 250-hp. turbine. The cost of the work is estimated at $350,000. The company has contracted to supply electricity to the Consolidated Light, Heat & Power Company. Under the terms of the contract the company is to supply a minimum of 3,000 kw. and a maximum of 5,000 kw., with provision for a further extension of the maximum to 15,000 kw. To supply the service the Virginia company will erect a high-tension transmission line from its plant at Cabin Creek to Huntington.

HUNTINGTON, W. VA.—Arrangements have been made with the Consolidated Light, Heat & Power Company to secure electricity from the Cabin Creek plant of the Virginia Power Company. An expenditure of about $100,000 will be required by the local company to utilize the energy to be supplied by the Virginia company. The Konova plant of the Consolidated company will continue to operate to its full capacity.

WASHINGTON, D. C.—Plans have been prepared by the Potomac Electric Company for improvements to its substation at 438 Washington Street, to cost about $17,000.

WASHINGTON, D. C.—Bids will be received by the Machinery and Engineering Materials Branch, Munitions Building, Washington, D. C., until April 29 (Circular M. E. 195), for furnishing 52,000 feet of cable and 24,000 feet messenger strand wire. Bids will also be received until April 20 (circular M. E. 194) for furnishing one storage battery, one slate panel, one switchboard, one combination generator and feeder panel, one battery charging panel, one 7½-hp. motor, one direct current generator and one flexible coupling.

North Central States

DETROIT, MICH.—The Board of Fire Commissioners, it is understood, is asking for bids for the construction of a central fire alarm station, 55 ft. x 109 ft., to be located at Macomb and Antoine Streets. Donaldson & Meier, Penobscot Building, Detroit, are architects.

DETROIT, MICH.—At an election held April 6 the proposal to issue $15,000,000 in bonds, the proceeds to be used to build a municipally owned street railway system, was carried. Work will begin at once on the proposed car line.

DETROIT, MICH.—Extensions and improvements contemplated to the municipal lighting system, to cost about $108,000, are under consideration by the Public Lighting Commission. The work will consist of laying conduits, installing cables and fitting up eighty-two lamp posts and arc lamps on Kercheval Avenue between Junction Avenue and Fourteenth Avenue, and also fitting circuit regulators in substation. The construction of underground conduits in a number of streets of the city, to cost about $151,000, is also under consideration.

LANSING, MICH.—Plans are being prepared for the construction of a new municipal electric light plant, to cost about $1,000,000. Alvord & Burdick, Hartford Building, Chicago, Ill., are engineers.

NORTHVILLE, MICH.—Plans for the proposed hospital group to be erected in Northville by the Detroit Board of Health provide for a separate power and heating plant. Stratton & Snyder, Union Trust Building, Detroit, are architects.

DOVER, OHIO—Contract for extensions to the municipal electric light plant has been awarded to the Joseph L. Skelton Engineering Company of Toledo, at $99,950. Under the terms of the contract the contractor is to take the old gas engine equipment.

HAMILTON, OHIO—Plans are being prepared by Bodenstein & Surman, architects, Cincinnati, for equipping the plant of the Herring-Hall-Marvin Safe Company with motor-driven machinery. The plans call for a new power plant and a new boiler room. The cost is estimated at about $80,000.

LOVELAND, OHIO—Bids will be received by Frank Chase, Loveland, until April 27, for construction of a municipal light plant. The cost is estimated at $125,000.

INDIANAPOLIS, IND.—Plans are being prepared by the Marietta Safe Cabinet Company for a new plant, to cost about $2,000,000. The building will include a main metal working plant, assembly building, power plant, chemical works and research laboratory. R. H. Dick is vice-president and general manager.

LOGANSPORT, IND. — The Indiana Public Service Commission has authorized a $50,000 bond issue for improvements in the municipal light plant.

CHICAGO, ILL.—Plans have been prepared by Marshall & Fox for a power station for the Commonwealth Edison Company to be erected on the Calumet River between 98th and 100th streets, to cost about $5,000,000.

DIXON, ILL.—The Public Utilities Commission has granted the Illinois Northern Utilities Company permission to construct and operate a transmission line connecting its Milan-Viola line with the plants of the Hydraulic Pressed Brick Company and other industrial concerns.

ELGIN, ILL.—The local electric plant of the Aurora, Elgin & Chicago Railroad Company was destroyed by the tornado on March 29.

ORION, ILL.—The Illinois Public Utilities Commission has granted the Sherrard Power System of Orion permission to extend its transmission lines from Orion to Osco and Lynn. The company was also authorized to erect a transmission line to Matherville and to extend its line from Preemption to Reynolds and furnish service to the Reynolds Light & Power Company.

RICHMOND, ILL.—Plans are under consideration for extensions to the municipal electric light plant, to cost about $200,000.

SPRINGFIELD, ILL.—Arc lamps will be installed by the City Council in South Fifth Street, pending an appeal to the Supreme Court of the state of the ornamental lighting system assessment case, which was decided against the city.

TAYLORVILLE, ILL.—At an election to be held April 29 the proposal to issue $80,000 in bonds for the installation of a municipal electric light plant will be submitted to the voters.

MILWAUKEE, WIS. — The Duplex Storage Battery Company, 637 Edison Avenue, is planning to build a plant in West Allis, to cost with equipment about $50,000.

SUPERIOR, WIS.—The installation of a lighting system on Tower Avenue this spring is under consideration by the City Commissioners.

ST. PAUL, MINN.—Bids, it is understood, will soon be asked for the installation of an ornamental street-lighting system on Summit Avenue, between Rice Street and the Mississippi River, to cost $104,000.

SAVAGE, MINN.—The village Council has granted the Lake Electric Company permission to erect an electric distributing system in certain streets of the village.

MAQUOKETA, IOWA.—The Iowa Electric Company has petitioned the Supervisors of Scott County for a franchise to erect a transmission line along the county road from Big Rock to Allen's Grove, and also to operate in the town of Big Rock. The company has applied to the Commissioners of Clinton County for permission to run continuous lines through Welton Township.

FULTON, MO.—The installation of a 250-kw. generating unit and engine in the plant of the municipal electric light and water works is under consideration. W. J. McCarroll is superintendent.

ST. LOUIS, MO. — Contract has been awarded by the Valley Electrical Company for the erection of a new plant on King's Highway Boulevard, between Kemper Park and Connecticut Street, to Henry Dilschneider, to cost about $300,000. The company has recently taken over the business and property of the St. Louis Electrical Works, now located at 4060 Forest Park Boulevard.

HETTINGER, N. D. — The electric plant of the Hettinger Electric Light & Power Company was recently destroyed by fire, causing a loss of about $20,000.

BEAVER CITY, NEB.—The installation of a 150-hp. engine and a 100-kva. generator in the municipal light and water works is under consideration. C. Roberts is manager.

HOWELL, NEB.—Plans are under consideration to change the system of the municipal electric light plant from direct to alternating current. G. Lodes is secretary.

HUTCHINSON, KAN. — Plans are being prepared by the United Water, Gas & Electric Company for improvements to its plant, including an addition to power house to provide space for two additional boilers. New pumps will also be installed.

Southern States

GASTONIA, N. C.—An election will soon be called to submit to the voters the proposal to issue $285,000 in bonds for extensions and improvements to the municipal electric light plant and waterworks system.

TIMMONSVILLE, N. C.—The plant of the local gas and electric company was recently destroyed by fire.

UNION, S. C.—The Council is considering calling an election to submit to the voters the proposal to issue $30,000 in bonds for extensions to the municipal electric lighting system.

ADEL, GA.—Improvements are contemplated to the municipal electric light plant, to cost about $14,000.

FERNANDINA, FLA.—Work has begun on the construction of a large phosphate plant for the Florida Phosphate Terminal Company, to cost about $500,000. The equipment will include power plant apparatus, crushing machinery, drying equipment, electrically-driven cars, etc. The plans provide for a separate power plant. Charles E. Waddell of Asheville, N. C., is engineer in charge.

CLARKSVILLE, TENN. — Preparations are being made by the Clarksville Electric Company to build a new electric plant.

BIRMINGHAM, ALA.—Work will begin at once by the Alabama Power Company for the construction of the 44,000-volt transmission line from Vida to Selma, a distance of about 30 miles.

BIRMINGHAM, ALA.—The Sloss-Sheffield Steel and Iron Company has applied to the city commission for a franchise to construct, maintain and operate a high-tension electric transmission line from its North Birmingham plant, through the city of Birmingham, to the southwestern limits of the municipality. The Sloss company proposes to operate its mines by electricity generated at its North Birmingham plant.

MONTGOMERY, ALA.—The Alabama Power Company of Birmingham has been granted permission by the War Department to erect a high-tension transmission line across the Alabama River in connection with its high-tension line from its hydro-electric plant at Lock 12 to Montgomery.

MONROE, LA.—Work will soon begin on the construction of the new municipal electric light and power plant. The Foundation Company, 233 Broadway, New York, N. Y., is contractor.

CLAREMORE, OKLA. — Bonds to the amount of $75,000 have been voted for improvements for the municipal electric light plant and waterworks system.

ABILENE, TEX.—The American Public Service Company of Chicago, Ill., has submitted a proposition to the city of Abilene to take over, rehabilitate and operate the local street-car system. The cost of such improvements is estimated at $50,000.

ALVIN, TEX.—The Alvin Ice, Light & Power Company contemplates the installation of complete machinery and equipment for an ice plant.

COLUMBUS, TEX.—Arrangements are being made by the Columbus Electric Light Company to enlarge its plant and to build an electric transmission line to Giddings, a distance of 3 miles.

DALLAS, TEX.—The Dallas Power & Light Company is contemplating the construction of a spray pond and cooling system at its local plant, to cost about $107,000.

DALLAS, TEX.—Plans are being prepared for an ornamental street-lighting system on North Harwood Street, to cost $25,000. George D. Fairtrace is engineer.

DENISON, TEX.—Plans are under consideration for new ornamental lamps to replace those now in use on Main, Elm and Commerce Streets. About 200 new lamp standards will be required, to cost about $70 each.

GONZALES, TEX.—Preparations are being made by the Houston-Guadalupe Water Power Company for the construction of a 1,000-hp. hydro-electric power plant on the Guadalupe River, to cost about $140,000. The plans include a transmission system, 60 miles long, to connect Guadalupe, Gonzales, San Antonio and other cities and towns, to cost from $250,000 to $300,000. Bids for construction, it is understood, will be asked within sixty days. E. Kennedy, Binz Building, Houston, is general manager.

Pacific and Mountain States

OLYMPIA, WASH.—Bids will be received at the office of Secretary of State Capitol Commission, until April 30, for the erection of the power house, chimney and tunnels, for the Capitol group for the State of Washington. Separate bids will be received at the same time for heating plant and other mechanical equipment. Plans and specifications are on file in the office of Wilder & White, architects, 50 Church Street, New York, N. Y., and of Bebb & Gould, architects, Temple of Justice Building, Oylmpia, where copies may be obtained.

ROSEBURG, ORE.—At an election to be held in May the proposal to issue bonds to the amount of $500,000 for construction of a municipal power plant and water system will be submitted to the voters. All previous bond issues on this project will be repealed.

VALE, ORE.—J. E. Johnson of Vale has filed application with the State Engineer for permission to divert the waters of the middle fork of the Malheur River in Harney County for a hydro-electric development. The construction of a canal and a municipal power plant is contemplated, to cost about $350,000.

ALAMEDA, CAL.—Plans for extending the municipal electric distributing system to Bay Farm Island are under consideration. The cost is estimated at $25,000.

ALAMEDA, CAL.—Contract has been awarded by the Electric Light Commissioners for the construction of a new substation on Webster Street and Atlantic Avenue, to cost about $60,000.

BUTTE CITY, CAL.—Application has been filed by N. A. Baker for the proposed Afton irrigation district, Butte City, for permission to take 60 cu.ft. per second from Sacramento River, Glenn County, for agricultural purposes on 2,000 acres. Diversion works, including a pumping plant, will cost about $20,000.

CHICO, CAL.—Application for permission to divert 12 cu.ft. per second of water from Hamlin slough, in Butte County, tributary to Butte Creek, for agricultural purposes on 2,768 acres, has been made to the State Water Commission by J. H. Jones of Chico. The project includes the construction of a dam and pumps.

LOCKPORT, CAL.—The Railroad Commission has granted the Snow Mountain Water & Power Company permission to issue $1,500,000 in capital stock for extensions to its electric power plant and system.

OAKLAND, CAL. — Extensive improvements are being made by the Pacific Gas & Electric Company to its local system involving an expenditure of about $750,000. New equipment including a 16,000-hp. steam-turbine generator with condensing apparatus and six new boilers of 822 hp. each will be installed in the First and Grove Streets power station.

REDDING, CAL.—Surveys are being made by the Pacific Gas & Electric Company for a 200-mile steel tower line from Pitt River power house site down the valley in Shasta County. Surveys are also being made for a dam across Pitt River in the Big Bend, near Henderson.

SACRAMENTO, CAL.—Martin & Carter of Sacramento have applied to the State Water Commission for permission to divert water from the Sacramento River in Sacramento County for a 430-acre irrigation project to cost about $425,000.

SALINAS, CAL.—Surveys are being made by the Coast Valleys Gas & Electric Company, 52 Sutter Street, San Francisco, for the erection of an auxiliary transmission line between Lagunitas and Soledad. The cost of the proposed line is estimated at about $100,000.

SAN FRANCISCO, CAL.—The South Yuba Mining & Development Company of San Francisco has filed application with the State Water Commission to take 125 cu.ft. per second from the south fork of the Yuba River, Nevada County, for power purposes. The cost is estimated at about $400,000.

WEED, CAL.—The Weed Lumber Company contemplates the installation of a 1,500-kw. turbo-generator. J. M. White is general manager.

WILMINGTON, CAL.—A second petition has been presented to the Board of Public Works asking for extension of the ornamental lighting system from B Street to Water Street and along the entire length of the Catalina Terminal property.

TONOPAH, NEV. — The Montezuma Mines Corporation contemplates equipping the machinery in its mines for electrical operation.

CLAYTON, N. M.—The installation of one 100-kva. generator in the municipal plant is contemplated. J. H. Bender is superintendent.

Canada

MACLEOD, ATLA. — Reconstruction of the entire distribution system of the municipal electric light plant is under consideration. V. Pearson is superintendent.

SOURIS, MAN.—Work, it is understood, will soon start on the erection of the proposed transmission line from Portage la Prairie to Morden via Roland.

HALIFAX, N. S.—Tenders, it is reported, will soon be asked by the Nova Scotia Power Commission, Halifax, for an 8,000-hp. hydro-electric development in St. Margarets Bay, about 20 miles from Halifax. H. K. Smith is chief engineer of the commission.

HAMILTON, ONT.—The installation of a fire-alarm system, to cost about $110,000, is under consideration. A. B. Ten Eyck is fire chief.

HAMILTON, ONT.—The Grand Trunk Railway Company is planning to erect a telephone line (for dispatching service) between Hamilton and Sarnia, a distance of 150 miles. The cost is estimated at about $200,000. C. Forrester of London is superintendent.

PETERBORO, ONT.—The Canadian General Electric Company of Toronto is considering further extensions to its local plant. J. J. Ashworth is assistant general manager.

ST. CATHARINES, ONT.—The Niagara, St. Catharines & Toronto Railway Company contemplates increasing the capacity of its local substation. E. W. Oliver is general superintendent.

TORONTO, ONT.—Work, it is understood, will begin at an early date on the French River project by the Ontario Hydro-Electric Power Commission. The proposed developments will supply electricity in the towns and districts of Sudbury, Sturgeon Falls, Callander and North Bay.

PORTNEUF, QUE.—The J. Ford Company contemplates a 3,000-hp. development on the St. Annes River, in connection with an extension to its pulp and paper plant.

Miscellaneous

PANAMA.—Bids will be received at the office of A. F. Flint, general purchasing officer, the Panama Canal, Washington, D. C., until April 22, for copper cable, storage batteries, cable end bells, receptacle boxes, conduletes, circular loom or conduit, cutouts, conduit elbows, hard horn fiber, electrical fixtures, renewable fuses, lamp guards, electrical water heaters, pipe-forcing jacks, blinker keys, sockets, switches, etc. Blanks and information relating to this circular (1359) may be obtained at the above office.

(Issued March 30, 1920)

1,334,492. SYSTEM OF FIELD EXCITATION FOR DYNAMO-ELECTRIC MACHINES; Chester T. Allcutt, Wilkinsburg, Pa. App. filed March 13, 1918. Flux under interpole regulated in accordance with load current.

1,334,943. TROLLEY; Christian Aalborg, Wilkinsburg, Pa. App. filed Feb. 19, 1914. Number of pivotally and resiliently mounted contact shoes independently and separately supported upon a pantograph frame.

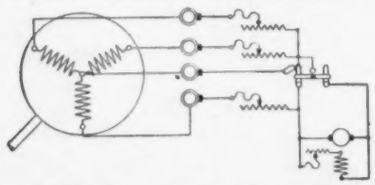
1,334,946. PRIMARY OR VOLTAIC BATTERY OR CELL; John P. Constable and Clarence G. Michalis, West Orange, N. J. App. filed Oct. 6, 1917. Frame clamped to negative electrode, assuring good contact.

1,334,962. APPARATUS FOR SUBJECTING SUBSTANCES OR MOLECULAR MATTER TO THE ELECTROSTATIC STRESS OF A HIGH-TENSION ELECTRIC DISCHARGE; Fred G. Niece, Cleveland, Ohio, and Ross M. Leggett, Akron, Ohio. App. filed March 25, 1919. Produces polymerization or alterations in chemical or physical structure.

1,335,009. PROCESS AND APPARATUS FOR MANUFACTURING STEEL ALLOYS; William E. Moore, Pittsburgh, Pa. App. filed Nov. 19, 1918. Steel for forging and rolling preheated and treated in successive electric furnaces.

1,335,014. ELECTRIC-CURRENT-REGULATING WALL SWITCH; Antonio Papini, Philadelphia, Pa. App. filed Aug. 11, 1919. Fibrous resistance material inclosed in switch.

1,335,015. CURRENT-REGULATING PLUG AND SOCKET; Antonio Papini, Philadelphia, Pa. App. filed Aug. 11, 1919. Combination socket and plug with inclosed resistance material for regulation.



No. 1,335,050. Alternating Current Motor

1,335,016. CURRENT-REGULATING TREADLE SWITCH; Antonio Papini, Philadelphia, Pa. App. filed Aug. 11, 1919. Compressible resistance material in switch container.

1,335,017. CURRENT-REGULATING PLUG AND PULL SOCKET; Antonio Papini, Philadelphia, Pa. App. filed Aug. 15, 1919. For medical batteries, lighting circuits and small motors.

1,335,018. CURRENT-REGULATING PLUG AND SOCKET; Antonio Papini, Philadelphia, Pa. App. filed Aug. 15, 1919. Contains insulating cylinder in shape of cup containing resistance material to be compressed by a piston.

1,335,019. CURRENT-REGULATING FOOT SWITCH; Antonio Papini, Philadelphia, Pa. App. filed Aug. 15, 1919. Metallic spring-pressed, foot-actuated button.

1,335,020. ELECTRIC HEATER FOR WATER AND OTHER LIQUIDS; Antonio Papini, Philadelphia, Pa. App. filed Aug. 28, 1919. Resistance units in series within porcelain-lined container.

1,335,021. CARBON COMB ELECTRODE; Antonio Papini, Philadelphia, Pa. App. filed Aug. 28, 1919. Carbon comb provided with projecting elements arranged in staggered order.

1,335,022. RHEOSTAT; Antonio Papini, Philadelphia, Pa. App. filed Oct. 13, 1919. Cylindrical container with layers of mica mixed with graphite in suitable proportions and disks of metal to be compressed.

1,335,023. CURRENT-REGULATING PLUG AND SOCKET; Antonio Papini, Philadelphia, Pa. App. filed Nov. 19, 1918. Graphite mixed with pulverized mica forms regulating material for pull socket.

1,335,050. ALTERNATING-CURRENT MOTOR; Valere A. Fynn, St. Louis, Mo. App. filed March 15, 1918. Single or polyphase alternating-current motors with phase-wound induced members.

1,335,075. ARTICLE OF MANUFACTURE; Richard D. Paxson, Cleveland, Ohio. App. filed Sept. 19, 1919. Electric floor lamps to harmonize with surroundings.

1,335,079. ELECTRIC FURNACE; Charles W. Speris, Battersea, London, Eng. App. filed June 10, 1919. Container composed of a material which constitutes conductor designed to be heated by a three-phase current.

Record of Electrical Patents

Notes on United States Patents

1,335,107. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Jan. 27, 1915. For alternating-current series commutator-type motors.

1,335,108. PHASE-CONVERTER SYSTEM; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed April 4, 1916. Phase converter operates at synchronous speed to insure power-factor adjustment and stable operation.

1,335,109. PHASE-CONVERTER SYSTEM; Rudolf E. Hellmund, Swissvale, Pa. App. filed Aug. 7, 1916. T-connected rotary type, provided with direct-current excitation for synchronous operation.

1,335,110. COMMUTATING MEANS FOR DYNAMO-ELECTRIC MACHINES; Rudolf E. Hellmund, Swissvale, Pa. App. filed Sept. 13, 1916. Commutating field winding excited under varying conditions of speed and load to compensate for sparking voltage under brushes.

1,335,111. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed Feb. 3, 1917. Automatic control of induction-motor circuits.

1,335,111. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed Feb. 13, 1917. Regenerative control with main dynamo-electric machine provided with an exciting field winding having a number of unequal parts.

1,335,119. HOLDING MEANS FOR MAGNETS; Terrence G. Louis, Springfield, Mass. App. filed March 26, 1919. Fork-like clip sprung over end of the magnet.

1,335,120. ELECTRICAL SYSTEM FOR AUTOMOBILES; Walter O. Lum, Wilkinsburg, Pa. App. filed Nov. 29, 1915. Protects lamps of lighting systems.

1,335,125. MARKING DEVICE; John H. Miller, Wilkinsburg, Pa. App. filed Aug. 7, 1917. Recording stylus periodically supplied from an external source.

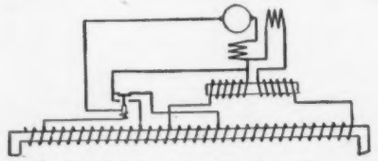
1,335,127. CONTROL SYSTEM; Laurence M. Perkins, Wilkinsburg, Pa. App. filed May 15, 1917. For alternating-current commutator-type motors.

1,335,129. VENTILATION OF DYNAMO-ELECTRIC MACHINES; Giulio Schroeder, Hale, Eng. App. filed Nov. 22, 1916. Ventilation of inclosed railway and mill motors.

1,335,139. THERMOSTAT SYSTEM; Frank Thornton, Jr., Pittsburgh, Pa. App. filed Oct. 2, 1914. Thermostat operates to close control circuit, but never interrupts it.

1,335,141. SYSTEM OF ELECTRICAL REGULATION; William A. Turbayne, Niagara Falls, N. Y. App. filed April 7, 1913. Variable-speed generator whereby generator voltage may be maintained substantially constant.

1,335,144. DYNAMO-ELECTRIC MACHINES; Miles Walker, Manchester, Eng. App. filed Sept. 30, 1916. For machines having commutating poles or compensating windings for securing better commutation over wide variations in load.



No. 1,335,127. Contro. System

1,335,147. ELECTRIC CLOCK; Poul P. Andersen, Taastrup, Denmark. App. filed Jan. 23, 1918. Pendulum rotates toothed wheel, causing a periodical circuit closing by electromagnet which attracts its armature.

1,335,148. ELECTRIC SECONDARY CLOCK; Poul P. Andersen, Taastrup, Denmark. App. filed Jan. 23, 1918. Electromagetic circuit closed and broken periodically by a mechanical or electrical master clock.

1,335,152. ELECTRICAL MEASURING INSTRUMENT; Charles B. Berst, Pittsburgh, Pa. App. filed July 3, 1916. Flat armature for ampere-hour meter with small air gap.

1,335,153. AUTOMATIC STARTER FOR AUTOMOBILES; William L. Bliss, Niagara Falls, N. Y. App. filed Nov. 25, 1912. Small motor employed which will drive starting motor as generator.

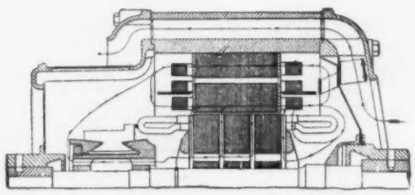
1,335,159. MEANS FOR SUPPORTING ELECTRODES IN IONIC TUBES; Frederick P. Driver, London, Eng. App. filed May 22, 1918. Tubes used as transmitting or receiving valves in wireless telegraphy.

1,335,174. ELECTROLYTIC APPARATUS AND METHOD; Matthew M. Merritt, South Middleton, Mass. App. filed Aug. 2, 1918. Use in connection with electrolytic deposits on cathodes.

1,335,175. ELECTROLYTIC APPARATUS AND METHOD; Matthew M. Merritt, South Middleton, Mass. App. filed Aug. 2, 1918. Provision for rapid and recurrent alternate immersion and emersion of cathode in electrolyte.

1,335,176. ELECTROLYTIC APPARATUS AND METHOD; Matthew M. Merritt, South Middleton, Mass. App. filed Aug. 2, 1918. Depositing copper to protect tips of aëroplane propellers.

1,335,177. ELECTROLYTIC METHOD AND APPARATUS; Matthew M. Merritt, South Middleton, Mass. App. filed Sept. 18, 1918. Manufacture of tubes for containers such as aëroplane radiators.



No. 1,335,129. Ventilation of Dynamo-Electric Machines

1,335,181. RHEOSTAT; John Parkin, Jr., San Rafael, Cal. App. filed Aug. 12, 1919. For radio signaling.

1,335,199. ELECTRIC FURNACE; Marcus Ruthenburg, Buffalo, N. Y. App. filed May 4, 1918. Resistance type adapted for reduction of elements from their compounds.

1,335,209. PROCESS FOR THE PREVENTION OF SELECTIVE CORROSION OF TUBES AND MACHINERY PARTS OF COPPER OR COPPER CONTAINING ALLOYS; Franz Von Wurstemberger, Zurich, Switzerland. App. filed June 7, 1919. Prevents pitting by introducing into water an easily soluble hydrolytically decomposable acid reacting salt.

1,335,210. METHOD AND DEVICE FOR THE PREVENTION OF SELECTIVE CORROSION AND TUBES AND MACHINERY OF COPPER OR COPPER CONTAINING ALLOYS; Franz von Wurstemberger, Zurich, Switzerland. App. filed June 11, 1919. Supplies from a chamber separted from but connected to water inlet of such machinery a salt having, when hydrolyzed, an acid reaction.

1,335,215. ANNUNCIATOR; Henry J. Appleton, Detroit, Mich. App. filed Sept. 15, 1919. Provided with operating apparatus to give a differential peripheral speed to indicating rolls.

1,335,219. COIL-UNIT AND SPARK-PLUG TESTER; Richard T. Carlson, Rosedale, Kan. App. filed Aug. 5, 1918. Spark-gap contactor in primary circuit for observing intensity of spark and for making adjustments.

1,335,256. SYSTEM FOR PROTECTING ELECTRICAL TRANSMISSION LINES; Waldemar Petersen, Darmstadt, Germany. App. filed Nov. 12, 1914. Switches for disconnecting a section of line are provided with retarding means controlled by device inserted into line and responsive to rapid electrical disturbing waves.

1,335,272. FINGER-ACTUATED SIGNAL LIGHT; Douglas J. Broughton, Springfield, Mass. App. filed March 20, 1918. For theater usher, to designate number of seats available.

1,335,295. BELL RHEOSTAT; Antonio Papini, Philadelphia, Pa. App. filed Oct. 13, 1919. Adjusts voltage by compressible resistance in porcelain case.